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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to ensure publication in that week's issue.

Recent tests by the Reichsanstalt of the German Nernst lamp give very encouraging results as to efficiency, the watts per candle-power being 1.65 with a straight filament and 1.42 for the bent filament, at the start. These values in the course of four hundred hours run to 1.97 and 1.75 respectively. The decrease in candle-power, however, is more than could be desired, being twenty-four and one-half per cent for the straight and thirty-one per cent for the bent filament for the four hundred hours. Considering the short time since the invention of this lamp, these figures are very creditable and doubtless much better results will be obtained in the near future.

THE BUILDERS OF THE TROLLEY.

Much has been written of recent years about the great benefits which have been secured through the development of electrical methods of transportation. It has been shown how the outlying districts have been brought in close touch with the large centres of industry; how, by bringing the suburbs within easy reach of the heart of the city, the business man could live in the country and yet carry on his business where it was most advantageous; how, by concentrating the business in a comparatively small section of the city, it could be carried on more efficiently and quickly than would be the case were it spread over a large area.

It has been shown how the health of the population has been improved by relieving the congestion of the large cities and replacing the old, unhealthy vehicles by clean, cheerful cars.

We have heard again and again the enthusiastic writer in the technical and daily papers expatiate upon the beauties and benefits of the trolley road.

Now, we will not admit that any one holds the electric road in greater esteem than we, nor can any have a better realization of the benefits accruing from the general adoption of this method of transportation. But have we not overlooked, in our ecstacy over the beauties of the trolley, one fact? Why is it that we are so favored to-day? How did it happen that we are so provided for now? The roads were not spontaneous growths, springing up by their own accord when needed. They have resulted from a careful study of the problems presented by the rapid growth of our cities.

Nearly twenty years ago the street railway men saw that something would soon have to be done. The horse-car lines had been outgrown. They cast about for other means of moving the cars. Various schemes were tried and discarded. Electricity was called upon, and in the first few experiments, while it did not give entire satisfaction, it seemed to promise better than anything else. However, much was to be done before it could be seen whether this method would meet the demands or not. Money was needed for experimenting on a commercial scale, and this was soon invested, although it was pretty well assured that the first attempts would not be commercially successful.

After many trials and as many failures, each of which taught its lesson, the necessary conditions for successful operation were understood, and the electric road became an acknowledged factor in our towns and cities. The growth has indeed been astonishing. Trolley lines not only form complete networks in all of our cities, but extend many miles into the outlying districts, bringing city and country closer together, until to-day a continuous ride of over 200 miles can be made in several localities.

But the public spirit of the early financiers of electric roads did not end with first experiments, though the money laid out then was not inconsiderable. There was a greater work to be done. Money must be had for the building of new lines and the electrification of old ones. When the necessity was shown, the capital was forthcoming, although immediate returns could not be expected and the ultimate financial success was sometimes in doubt.

Fortunate, indeed, are we of the United States that there were in those days men with public welfare at heart and with the means for backing these enterprises. To-day there can be no doubt of the success of the electric road, both as a means of transportation and as a safe investment, but, while we should not lose sight of the men who made the electric road an engineering success, neither should we forget the men who made that success possible at the risk of financial loss, and who are still engaged in promoting electric railway improvements and extensions

from which the returns must necessarily, in many instances, be slow.

The recent reduction in the price of electricity which has been made by the New York Edison Company will have a stimulating effect upon the use of that form of energy. The one drawback which has prevented the almost exclusive use of electricity for light, heat and power has been its cost. In cleanliness, safety, convenience and flexibility no other agent can be compared to it. The fate of the gaslight was postponed by the invention of the Welsbach mantle. Now in the face of a general reduction of twenty-five per cent in the cost of electricity some more radical improvement than that of Welsbach will have to be made, if the use of gas is to continue in anything like its present extent.

There is much satisfaction to be derived from the knowledge that the question of an improved form of electric light is engaging the attention of some of our best engineers. A patent has been granted to Mr. C. P. Steinmetz for a new type of filament or glower which is expected to give excellent results. With the invention of this and that of the Nernst lamp, some progress has been made in the direction of cold light. Since at present the light efficiency of an incandescent lamp is only six per cent and that of the arc about ten per cent, it is to be hoped that we will soon be realizing the benefits of the work of these engineers.

It is interesting to notice that our British cousins are coming to the same conclusion in regard to railway operation that has been arrived at in this country. More time can be saved by using a high rate of acceleration which enables the train to get away from the station quickly rather than by an ultimate high speed. In a description of the new equipment of the Liverpool overhead railway it is shown that this new apparatus with its rapid acceleration would reduce the time of the trip from thirty-two to twenty and one-half minutes and at the same time cut down the number of trains from fourteen to twelve.

POWER TRANSMISSION BY CONTINUOUS CURRENTS.

Elsewhere in this issue will be found a description of an interesting hydro-electric transmission plant at Lausanne, Switzerland. The water power, which is owned by the city of Lausanne, is at St. Maurice on the Rhone, about forty miles distant, 14,000 horse-power being available.

Given these conditions, one would expect to find the standard three-phase, high-voltage transmission system using alternators coupled directly to the turbines and operated in parallel. The line would be fed through an elaborate switchboard and large transformers equipped with auxiliary cooling apparatus. At the receiving end there would be step-down transformers feeding into the distributing network for light and power, and where continuous current is called for a rotary converter or motor-generator set would be installed. Naturally in this system the switchboards and transformers form an important part of the installation.

The engineers of this plant, however, have adopted a continuous, constant-current system. The high pressure of 25,000 volts is obtained at the generating station by operating all the generators in series. The motors at the several receiving stations are also connected in series, each taking about 2,100 volts. The reasons given for this selection are reliability of service, ease of regulation and a smaller first cost than would have been the case for a three-phase system.

The plan differs so radically from the accepted standards in this country that it is interesting to see wherein lie the advantages named above. The claim to reliability seems to be based upon the simplicity of the plant. Each of the five turbines drives two direct-connected generators, and all ten of these generators are connected in series. This is a simpler arrangement than the parallel method of connection, and has one great advantage—no switchboard is needed. This complicated and expensive accessory is replaced by a single, double-pole switch for short-circuiting the line and the machines when it is necessary to shut down. The two banks of transformers, with their blowers and high-tension pneumatic oil-break switches, which would be required by the parallel system, are not needed. There is but one governor to control simultaneously the speed of all of the turbines. With the continuous-current series system, there is no synchronizing to be done and no real need that the machinery operate at exactly the same speed. This is imperative for parallel operation, and is one of the difficult problems facing central station engineers to-day.

At the receiving station each motor is supplied with a small starting switchboard consisting of ammeter, voltmeter and starting switches. To supply light, two motors drive directly three-phase generators giving the receiving station perfect control of the voltage of the distributing system.

The saving in first cost in this plant over the three-phase system arises from the saving in accessory apparatus which the system permits. While the additional copper required over what would be called for by the three-phase plan must be reckoned, this item is certainly small compared with the saving indicated above. Another point worthy of notice is that for the local supply in the neighborhood of the generating station, a three-phase alternating-current system is used, thus actually reversing our usual practice of using continuous current for local supply and three-phase alternating currents for transmission.

While it is doubtful whether any engineer in this country would at this time advocate a system so radically different from current practice, the reasons for this choice in planning the Lausanne installation seem to be sound. That the operation of the plant will be successful can not be doubted, as there are already a number of similar plants which are apparently giving entire satisfaction. The scheme would at least seem worthy of study by our own engineers, with a view of ascertaining if there is anything to be learned from their experience.

It is worthy of note that the question of the advisability of the more extended application of double-current generators has been provocative of some lively discussion abroad. This class of apparatus has been giving excellent satisfaction in this country for the last few years and we are glad to notice that it is beginning to be appreciated elsewhere. Things seem to be moving in the old country.

"THE DISSIPATION OF ENERGY BY ELECTRIC CURRENTS INDUCED IN AN IRON CYLINDER WHEN ROTATED IN A MAGNETIC FIELD"—II.

BY ERNEST WILSON.

ALTERNATING MAGNETIC FORCE.

Fleming* gives the expression $0.616 \frac{B^2 f^2 d^2}{10^{16}\rho}$ in a uniform magnetic field for the watts dissipated by induced currents per cubic centimetre of a cylinder to which an alternating magnetic force is applied whose direction is parallel to the longitudinal axis of the cylinder. The diameter of the cylinder is d centimetres, and the other symbols represent the same quantities as before. This formula for frequency 129 and $\rho = 13 \times 10^{-6}$ ohms is approximately verified by experiment. The following results were obtained with a cylinder of mild steel four inches (10.16 cm.) diameter, † and have been extended to the case of a cylinder 0.1 cm. diameter on the assumption that similar electric and magnetic events happen in cylinders of different diameters at times varying inversely as the square of their diameters:

Maximum average B at centre of cylinder.	Maximum average B over whole cylinder.	Frequency with the cylinder 10.16 cm. diameter.	Ergs per cycle per cubic centimetre.	Frequency with a cylinder 0.1 cm. diameter.	Watts per cubic centimetre of a cylinder 0.1 cm. diameter.	Fleming's formula $d = 0.1$ cm.
7690	6888	1/80	3820	129	0.049	0.037
15000	17050	"	26200	"	0.338	0.222
1630	4710	1/20	2750	516	0.142	0.282
15500	20000	"	54500	"	2.810	5.07

Turning from round wires to plates, in which the cross-section normal to the lines of force has a length great as compared with its thickness, Fleming‡, Steinmetz,§ and Thomson‖ agree in giving $1.66 \frac{B^2 f^2 t^2}{10^{16}\rho}$ for the watts per cubic centimetre. A plate would, therefore, dissipate nearly 2.7 times as much energy in a given time as a wire having a diameter equal to the thickness of the plate.

ROTATING AND ALTERNATING MAGNETIC FIELDS.

We have seen that the results of theory are fairly well verified by experiment. It remains to extend the formulæ to cases actually met with in the construction of dynamo electric machinery. It is reasonable to assume that the electric currents distribute themselves in paths such that constant current density is preserved. The formula $2.78 \frac{B^2 f^2 t^2}{10^{16}\rho}$ may be taken to apply with a good deal of certainty in the case of circular plates in which the diameter is great as compared with the thickness, and in which the lines of force are uniformly distributed in the plane of the plate. Comparing this with the formula $1.65 \frac{B^2 f^2 t^2}{10^{16}\rho}$ for alternating magnetic force we may say that the rotating field would dissipate about 1.7 times as much energy in a given time as the alternating magnetic field. It should be remembered, however, that even when the lines of force are confined to the plane of the plate the dissipation of energy for a given average induction density may be considerably reduced if the distribution is such as to give the induced electro-motive force a more rectangular wave-form. Some time ago* I tried to account for the loss in a smooth-core drum armature, in which the magnetic field was distributed approximately as in these experiments. Bringing to bear the results of Professor Baily's experiments† on the dissipation of energy by magnetic hysteresis in rotating magnetic fields and the results arrived at in this paper, I am still unable to account for the observed loss on the assumption that the plates are insulated from one another. In dynamo-electric machines, where approximate uniform rotating fields are met with, the construction does not lend itself to such perfect conditions as, for instance, in the case of alternate current transformer cores. It is doubtful if the lines of force are always confined to the plate. If one considers the section of an armature core in which ventilating spaces are provided, it is highly probable that at the ends of the core and at each ventilating space there is a considerable axial component, which would at once give rise to a serious increase in the dissipation of energy by induced currents. The teeth are sometimes filed out after placing the plates in position, and this may lead to considerable conductivity normal to the plane of the plate. Then, again, the plates are not always insulated from the shaft or spider which supports them. In multipolar dynamos it is questionable if one ever meets with a fair approximation to a uniform rotating field.

LONGITUDINAL VARIATION OF INTENSITY OF MAGNETIC INDUCTION.

In the previous paper it was stated that the intensity of magnetic induction diminishes in value and suffers retardation in phase as one proceeds from either end of the cylinder along its longitudinal axis toward the centre, in much the same way as was observed radially in a plane at right-angles to the longitudinal axis and midway between the ends of the cylinder. This statement rested upon a comparison of the electro-motive force of coil I with that of coil 1. In the present experiments an opportunity to examine this further was given, and coil 3′ (Fig. 1) was wound round an area 22.6 sq. cm. at the end of the cylinder. The maximum values of the induction density over this area are given in table I, so that a comparison can be made with the maximum value of the intensity of induction at the centre (coil 1). The phase-displacements are also given. The results further confirm the statement made in the previous paper.

CONCLUSION.

In my former paper I omitted to thank Professor Capper for the loan of the worm and worm-wheel used in these experiments. I have pleasure in doing so now. I have also pleasure in acknowledging the help I have received from Mr. F. S. Robertson, and Messrs. M. S. Duffitt and R. M. Wartze. I wish to mention the intelligent interest taken by Mr. Duffitt in the theoretical part of the work, and the patience and care Mr. Wartze has given to the working out of results. Mr. T. Jones has again rendered valuable assistance.

THEORETICAL APPENDIX.

BY J. B. DALE, M. A.

(1) The rotation of a conducting sphere in a magnetic field is discussed by J. J. Thomson ("Researches in Electricity," p. 546).

When the sphere is rotating about the axis of z, in a uniform magnetic field of force B parallel to x, the values of the current components when $\sqrt{(\mu\omega/\sigma)}\, a$ is very small are,

$$p = -\tfrac{3}{2} \frac{\mu\omega}{(\mu+2)\sigma} z\mathrm{B}, \quad q = 0,$$

$$r = \tfrac{3}{2} \frac{\mu\omega}{(\mu+2)\sigma} x\mathrm{B},$$

ω being the angular velocity and a the radius. In the case of an iron sphere we may take $\mu = 10^3$, $\sigma = 10^4$, and the current components are approximately

$$-\tfrac{3}{2}\frac{\omega}{\sigma} z\mathrm{B}, \quad 0, \quad \tfrac{3}{2}\frac{\omega}{\sigma} x\mathrm{B}.$$

The currents therefore flow in circles in planes parallel to yz, having their centres on the axis of y.

Integrating round a circle the value of the electro-motive force is found to be $3\pi\rho^2\omega\mathrm{B}$. This is likewise the value of the electro-motive force found on the assumption that the circuit is insulated and rotating in a field of magnetic induction equal to that in the sphere at rest.

* See "The Alternate Current Transformer," vol. ii, p. 487.
† See Hopkinson and Wilson, "Phil. Trans.," A, vol. clxxxvi (1895), pp. 93–121.
‡ See "The Alternate Current Transformer," vol. ii, p. 490.
§ See Wiener's "Dynamo-Electric Machines," p. 119.
‖ See "Phil. Trans.," A, vol. clxxxvii (1896), p. 723.

* See *The Electrician* (London), October 11, 1895.
† See "Phil. Trans.," A, vol. clxxxvii (1896), p. 723.

The rate of heat production

$$= \sigma \iiint (p^2 + r^2)\, dx\, dy\, dz$$

taken throughout the volume of the sphere.

Transforming to polar co-ordinates this becomes

$$\tfrac{8}{4}\frac{\omega^2}{\sigma} B^2 \int_0^a r^4 dr \int_0^{\pi} \sin^3\theta\, d\theta \int_0^{2\pi} d\phi = \tfrac{8}{5}\frac{\pi a^5 \omega^2 B^2}{\sigma}.$$

Writing for ω, $2\pi f$ when f is the frequency, we find for the rate of heat production per cubic centimetre.

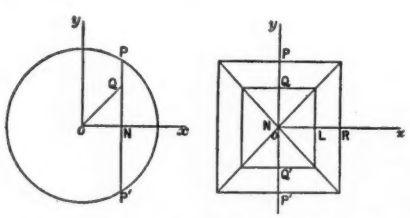
$$3.95\,\frac{a^2 f^2 (3B)^2}{\sigma},$$

when 3B is the induction when the sphere is stationary.

(2) In the case of a cylinder rotating about its axis of figure in a uniform magnetic field at right angles to the axis, we may assume in analogy with the result for a sphere, that the induced currents circulate in planes parallel to the axis and the magnetic force, and that the electromotive force in any circuit is the same as that which would be induced in the circuit supposed insulated and rotating in the magnetic field which exists in the cylinder at rest.

The form of the stream lines in any plain section is unknown. It is reasonable to assume that they are approximately rectangular. Different assumptions may be made regarding the law of formation of the rectangular circuits. We shall assume (1), that in any section the currents flow in rectangles similar to the boundary of the section; (2), that the currents flow on the surface of cylinders similar to the cylinder; (3), that the current density in any circuit is constant throughout that circuit, and compare the results obtained for the value of the rate of heat production according as one or other of these hypotheses is adopted.

(3) Take axes through the centre of the cylinder, O_z the axis of rotation, O_y parallel to the magnetic induction in the cylinder.



Let a cm. be the radius, and $2ma$ cm. the length of the cylinder, $2\pi f$ the angular velocity. In a section PNP′ distant x cm. from the axis, assume that the currents flow in circuits similar to the boundary of the section.

Let NL = z cm., then

$$NQ = z\sqrt{\frac{(a^2 - x^2)}{ma}} \text{ cm.}$$

If B is the magnetic induction, and ρ the specific resistance of the material in ohms, the electro-motive force in the circuit QLQ′

$$= 2\pi f B \,.\, 4z^2 \sqrt{\frac{(a^2 - x^2)}{ma}} \,.\, 10^{-8} \text{ volts,}$$

and the resistance

$$= 4\,\rho\left(z\frac{\sqrt{(a^2 - x^2)}}{ma} + z\frac{ma}{\sqrt{(a^2 - x^2)}}\right) \Big/ \delta x\, \delta z.$$

Hence the rate of dissipation of energy in watts per cubic centimetre

$$= \frac{16\pi f^2 B^2 10^{-16}}{\rho m^2 a^4} \int_0^a dx \int_{ma}^{} dz \frac{z^3 (a^2 - x^2)^{\frac{3}{2}}}{[(1 + m^2) a^2 - x^2]}$$

This may be integrated by substituting $a \sin\theta$ for x, and the result is

$$\frac{f^2 B^2 10^{-16}}{\rho} \pi a^2 m^2 \left[4 - \frac{2m^2}{\sqrt{(m^2 + 1)}} \log \frac{\sqrt{(m^2 + 1)} + 1}{\sqrt{(m^2 + 1)} - 1}\right]$$

When $m = 1$, this is equal to

$$4.694\,\frac{f^2 B^2 10^{-16} a^2}{\rho}$$

When m is small, the expression tends to

$$12.6\,\frac{f^2 B^2 10^{-16} a^2 m^2}{\rho}$$

(4) When the currents are assumed to flow in cylindrical shells similar to the original, let $2z$ cm. be the length. The radius of the shell = z/m cm.

The thickness of the plane end is δ_z, and of the curved surface $\frac{1}{m}\delta_z$.

Denoting by ϕ the angle xOQ, Fig. (i), the electro-motive force round the elementary circuit.

$$= \pi^2 f B 10^{-8} \,.\, 4\,\frac{1}{m} z^2 \sin\phi.$$

The resistance of the circuit

$$= \left(\frac{4.3 z^2}{3\delta\phi\delta z} + \frac{4 m_3 \sin\phi}{m_3 \delta\phi \delta_3 \sin\phi}\right)\rho = \frac{4(m^2 + 1)}{\delta\phi\delta^4}\rho.$$

The dissipation of energy in watts per cubic centimetre is

$$\frac{16\pi f^2 B^2 10^{-16}}{m^3 (m^2 + 1) a^3 \rho} \int_0^{\frac{1}{2}\pi} \sin^2\phi\, d\phi \int_0^{ma} z^4 dz =$$

$$\frac{4\pi^2}{5(m^2 + 1)} m^2 a^2 \,\frac{f^2 B^2 10^{-16}}{\rho}$$

When $m = 1$, this is equal to

$$\frac{2\pi^2}{5} a^2 \,\frac{f^2 B^2 10^{-16}}{\rho}$$

or

$$3.95 a^2 \,\frac{f^2 B^2 10^{-16}}{\rho}$$

When m is very small the value is approximately

$$7.9 m^2 a^2 \,\frac{f^2 B^2 10^{-16}}{\rho}$$

(5) When the current of any section is assumed to be of uniform density throughout, the rectangular circuit must be such that QL being this circuit QP = LR.

The area enclosed by the circuit is

$$4z\left(\sqrt{(a^2 - x^2)} - ma + z\right) (\alpha), \quad \text{or}$$
$$4y\left(ma - \sqrt{(a^2 - x^2)} + y\right) (\beta),$$

and the length

$$4\left(2z + \sqrt{(a^2 - x^2)} - ma\right) (\alpha), \quad \text{or}$$
$$4\left(2y + ma - \sqrt{(a^2 - x^2)}\right) (\beta),$$

the form α or β being taken according as ma is less or greater than $\sqrt{(a^2 - x^2)}$.

Hence the rate of dissipation of energy in watts per cubic centimetre is A + B, where

$$A = \frac{16\pi f^2 B^2}{ma^3 \rho 10^{16}} \int_0^{a\sqrt{(1 - m^2)}} dx \int_0^{ma} \frac{(\sqrt{(a^2 - x^2)} - ma + z)^2 z^2}{(\sqrt{(a^2 - x^2)} - ma + 2z)}\, dz$$

and

$$B = \frac{16\pi f^2 B^2}{ma^3 \rho 10^{16}} \int_{a\sqrt{(1 - m^2)}}^{a} dx \int_0^{\sqrt{(a^2 - x^2)}} \frac{(ma - \sqrt{(a^2 - x^2)} + y)^2 y^2}{(ma - \sqrt{(a^2 - x^2)} + 2y)}\, dy$$

When m is greater than unity the integral B alone is taken, the limits of x being 0 and a.

To integrate A with respect to z, let

$$\sqrt{(a^2 - x^2)} - ma = 2D \quad \text{and} \quad z + d = \xi.$$

Then

$$\int_0^{ma} \frac{(\sqrt{(a^2 - x^2)} - ma + z)^2 z^2}{(\sqrt{(a^2 - x^2)} - ma + 2z)}\, dz = \int_D^{ma + D} \frac{(\xi^2 - D^2)^2 d\xi}{2\xi} = \tfrac{1}{2}\int_D^{ma + D} \left[\frac{\xi^4}{4} - \xi^2 d^2 + d^4 \log \xi\right],$$

or, restoring the values of D and ξ,

$$\frac{1}{2^4} ma\,(\sqrt{(a^2 - x^2)})\,(4ma\sqrt{(a^2 - x^2)} - m^2 a^2 - (a^2 - x^2)) + \frac{1}{2^5}\sqrt{(a^2 - x^2)} - ma)^4 \log \frac{\sqrt{(a^2 - x^2)} + ma}{\sqrt{(a^2 - x^2)} - ma} \quad (C)$$

A similar substitution in B yields as the result of integration, with respect to z.

$$\frac{1}{2^4} ma\,\sqrt{(a^2 - x^2)}\,(4ma\sqrt{(a^2 - x^2)} - (m^2 a^2 - (a^2 - x^2)) + \frac{1}{2^5} ma - \sqrt{(a^2 - x^2)})^4 \log \left(\frac{ma + \sqrt{(a^2 - x^2)}}{ma - \sqrt{(a^2 - x^2)}}\right) \quad (C')$$

Since (C) and (C′) are identical in form, we can combine them, and integrate with respect to x from $x = 0$ to $x = a$.

Let $x = a \sin\theta$, and denoting $\cos\theta$ by c and $\sin\theta$ by s, we obtain

$$\int_0^a (C + C')\, dx = \frac{ma^5}{2^4} \int_0^{\pi/2} c^2 (4mc - c^2 - m^2)\, d\theta =$$

$$\frac{ma^5}{2^4}\left(\frac{8}{3}m-\frac{(3+4m^2)\pi}{16}\right) \quad (E)$$

By the same substitution D and D′ assume the forms

$$D=\frac{a^5}{2^5}\int_0^{\cos^{-1}m} c\,(c-m)^4\log\frac{c+m}{c-m}\,d\theta \quad (F)$$

$$D'=\frac{a^5}{2^5}\int_{\cos^{-1}m}^{\pi/2} c\,(m-c)^4\log\frac{m+c}{m-c}\,d\theta \quad (G)$$

where the limits in D′ when $m>1$ are 0 and $\pi/2$. Taking this case first and integrating by parts,

$$D'=\frac{a^5}{2^5}\Big[(sm^4-2(cs+\theta)m^3+2(c^2s+2s)m^2-\tfrac{1}{2}(2c^3s+3cs+3\theta)m+\tfrac{1}{15}(3c^4s+4c^2s+8s))\log\frac{m+c}{m-c}\Big]_0^{\pi/2} \quad (H)$$

$$+\frac{ma^5}{2^4}\int_0^{\pi/2}\frac{s}{m^2-c^2}\left[(m^4+4m^2+\tfrac{8}{15})s-m(2m^2+\tfrac{3}{2})cs+(2m^2+\tfrac{4}{15})c^2s-mc^3s+\tfrac{1}{5}c^4s-m(2m^3+\tfrac{3}{2})\theta\right]d\theta \quad (K)$$

The integrated part vanishes at the limits, and the remainder on integration becomes

$$\frac{ma^5}{2^4}\Big[(m^4+4m^2+\tfrac{8}{15})\frac{\pi}{2m}(m-\sqrt{(m^2-1)}-m(2m^2+\tfrac{3}{2})\Big(1-\sqrt{(m^2-1)}\tan^{-1}\frac{1}{\sqrt{(m^2-1)}}\Big)+(2m^2+\tfrac{4}{15})\frac{\pi}{4}(m-\sqrt{(m^2-1)})^2-m\Big(-\tfrac{1}{3}+m^2\Big(1-\sqrt{(m^2-1)}\tan^{-1}\frac{1}{\sqrt{(m^2-1)}}\Big)\Big)+\frac{\pi}{80}([m-\sqrt{(m^2-1)}]^4+2[m-\sqrt{(m^2-1)}^2])-2(2m^2+\tfrac{3}{2})\Big(k-\frac{k^3}{3^2}+\frac{k^5}{5^2}-..\Big)\Big] \quad (L)$$

when $k=m-\sqrt{(m^2-1)}$.

In the particular case when m = 1, the value is—

$$\frac{16\pi f^2B^2 10^{-16}a^5}{a^3\rho 2^4}\left[\frac{8}{3}-\frac{7\pi}{16}+\frac{83\pi}{30}-\frac{7}{2}+\frac{17\pi}{30}-\frac{2}{3}+\frac{3\pi}{80}-7\left(1-\frac{1}{3^2}+\frac{1}{5^2}+\frac{1}{7^2}+\ldots\right)\right]$$

The value of the series

$$1-\frac{1}{3^2}+\frac{1}{5^2}-\frac{1}{7^2}+-$$

can be found to be 0.9160. Hence we obtain for the number of watts—

$$4.095\,\frac{f^2B^2a^3 10^{-16}}{\rho}$$

The integration of F and G when $m<1$ is troublesome, but when m is sufficiently small, we may without much error neglect G, and integrate F from 0 to $\pi/2$.

$$\frac{a^5}{2^5}\int_0^{\pi/2} c(c-m)^4\log\frac{c+m}{c-m}\,d\theta = \frac{a^5m}{2^4}\int_0^{\pi/2} c^4\left(1-4\frac{m}{c}+\frac{19}{4}\frac{m^2}{c^2}-\frac{16}{3}\frac{m^3}{c^3}+\ldots\right)d\theta = \frac{a^5m}{2^4}\left[\frac{3}{16}\pi-\frac{8}{3}m+\frac{19}{16}m^2\pi-\frac{16}{3}m^3-\ldots\right] \quad (M)$$

Adding (E) and (M) we obtain

$$\frac{9}{8}\pi^2a^2m^3\cdot\frac{f^2B^2 10^{-16}}{\rho}=11.1\,a^2m^2\cdot\frac{f^2B^2 10^{-16}}{\rho}$$

TABLE I.

Periodic time in seconds.	Frequency for a cylinder having diameter and length = 0.1 cm.	Maximum average induction per square centimetre B.				Phase difference between E.M.F. curves. 360° = 1 period.			Watts dissipated by induced currents in half volume of the cylinder.			
		Coil 1.	Coil 2′.	Coil 3′.	Coil 4.	Nos. 1 and 3′.	Nos. 4 and 1.	Nos. 4 and 2′.	Calculated from $2.09\frac{\pi B^2 f^2 l^5}{10^{16}\rho}$ No. 4 coil E.M.F., rectangular.	Obtained from experiment.	Calculated from $3.95\frac{\pi B^2 f^2 l^5}{10^{16}\rho}$	Ratio A/B.
										B	A	
45	1434	429	541	1546	1090	65°.6	73°.7	28°.8	0.0127	0.0137	0.0240	1.75
"	"	908	3070	7860	5900	121°	108°	59°.4	0.373	0.224	0.705	3.15
"	"	12980	12400	12000	12600	28°	17°.6	8°	1.70	2.280	3.22	1.41
"	"	18200	20000	—	20000	—	0	0	4.28	5.8	8.10	1.40
90	717	730	895	1400	1060	44°.8	39°.2	16	0.0030	0 0036	0.0057	1.58
"	"	2660	5100	8100	6700	96°	82°.5	36°.8	0.119	0.138	0.227	1.64
"	"	13100	13400	13800	13300	5°.8	4°.8	0	0.472	0.708	0.895	1.26
"	"	17900	19300	17000	19300	0	0	0	0.993	1.41	1.88	1.33
360	179	1520	1320	—	1040	—	8°	0	0.00018	0.00027	0.00034	1.27
"	"	8400	8330	—	7300	—	0	0	0.0088	0.0135	0.0168	1.24
"	"	13740	14100	13400	14400	1°.6	0	0	0.0346	0.045	0.0655	1.45
"	"	20000	20600	—	19900	—	0	0	0.0662	0.0974	0.125	1.28

An Open Letter.*

You will, of course, pardon my remarking that I do not think much of the articles in your journal as a general rule. They do not seem to teach me anything, and that, I take it, is the criterion of a useful article.

Now, I have always suffered from an excessive modesty, and I know, therefore, that, having brought myself to the point of writing to you, what I write must be going to fill a long-felt want, and must be substantially correct; therefore, you will be good enough to put up a notice in your paper that correspondence on the contents of this letter can not be tolerated. I am by no means a bigoted or narrow-minded man, but I feel that it would be such a waste of time for controversially inclined folk, who are not so well informed on these matters as myself, to endeavor to refute my statements. First of all I think you ought to know, and will be interested in knowing, who and what I am.

Briefly, then, I am a well-to-do grocer in a town boasting me as one of its councilors, and having, in addition, an installation of electric light. There is, moreover, a considerable electric car service, so that you will own I live in an atmosphere that must be saturated with electricity, accounting, doubtless, for my assimilation of a certain knowledge of the science. My early training and environments were such that I often wonder why I continued to follow the profession of errand boy and window-cleaner in my father's emporium, and finally graduated behind the counter; but I as often console myself with the thought that genius longest hidden burns brightest in the end.

Almost before I had forgotten the feeling of a nascent front tooth, my attentive parents must have discovered in me a thirst for science equaling my more natural desire, for they demonstrated before me the essential facts of magnetism with the aid of a few tin ducks and a magnet with inconsequent poles.

In those days I continually heard grave elders remark that electricity was in its infancy, and as I lay in my nurse's arms (so forward was I) I used to think how nice it was that we two—electricity and I—would be growing up together; but, as I am still led to understand that little electricity has not been put into shorts yet, I feel that I have outstripped progress.

Since the days of the magnetized ducklings I have possessed large horseshoe

* From the London *Electrical Review*.

magnets of my own, and I have charged the glass and zinc cells that work the bells, and I have watched a friend of mine who combines electrical engineering and ironmongery connecting up such intricate things as the indicators for bells. This friend pays about thirty shillings a year to put A. I. E. E. after his name, and sometimes goes to London to take tea with his professional brethren.

In addition to this experience, my son has a friend who is a motorman, or an assistant engineer, I never quite understood which, on the tramways. (I think he must be a motorman, because I know that the motormen get more than the assistants, and I am sure my son would know only the best class.)

My son picks up a lot of curious information from this quarter and retails it to me.

Since I have been on the electricity committee of the town council I have gained most valuable experience, and am pleased to think I have not been slow to give less fortunate, or less teachable, people the benefit of it. Alas, how often one finds that one's best efforts to increase the world's quantum of intelligence are ill received—even, at times, rudely rebuffed! For instance, it was not long since that I dropped in at our electricity works—we supply light to the town at a loss, and power to the traction company at a large profit—as I often do, just to assure myself that everything is going smoothly. I found our engineer storming like a madman at the poor firemen, who appeared unable to raise enough pressure. I dislike above all things an exhibition of temper, especially before one's subordinates, so, the force of example being proverbial, and seeing, in my quick way, an easy solution of the present difficulty, I pulled the lately purchased evening paper from my pocket, and stepped silently and calmly to the nearest furnace. The door of this I opened, and immediately clapped the paper over the orifice merely following therein the practice of the housemaid who wishes to rouse a sluggish fire to life. Who would have believed that such a simple action could cause results so curious and diverse in the beholders! What the engineer said I can not repeat, and only partly understood, and I did not remain longer in the place when I saw the firemen drop their iron implements and double up with laughter. An incident such as that only proves the more conclusively how widespread is the ignorance of common things. Now, I have never seen any mention in your columns of the foregoing elementary recipe, nor of that other which recommends a vertically placed poker to the same end. In my opinion, no boiler-house should be without its "drawing poker," if I may coin the word.

Of course, before we decided to give the town an electricity station, we had to travel over most of Europe, and the whole of the British Isles, in order to make quite sure that electricity was the best luminant, and to decide as to the best method of generating it, that is to say, whether statically or on the multiple-unit system, or again alternatively. That reminds me of a little incident that occurred when I was going over a station toward the end of our labors. The engineer warned us not to go too near the machines if we wore watches. I showed mine to him, and said it would not be affected as it had already stood 2,000 volts on an alternator. He laughed and asked me where I held it, so I told him only a foot or two away from the commutator. He laughed again and said that evidently the watch would be all right in his station, as the power was only 200 volts. As a matter of fact, the thing has never gone properly since, and I cannot make up my mind as to whether the engineer or I was a fool.

We had a very enjoyable and instructive time on the Continent, and the engineer whom we had taken with us was able, with our assistance, to compose a long and valuable report; but, when this was presented to the committee, those members who had not gone with the deputation were not able to satisfy themselves that we had seen all that we might, and felt so much anxiety at the bare possibility of our having missed just the one system which might be going to revolutionize the supply of electricity that they resolved, and obtained the sanction of the council, to go out themselves, determining even to take in America on the way home.

I am always thinking of little things which might help to make our station pay better. Sometimes I lie awake all night working out some idea from its small beginning to its finished state, perfect, in every detail. It was only last week that an epoch-making scheme occurred to my restless mind, and I positively had to get up at 4 A. M. to tell the engineer; for I thought what an incalculable loss it would be to the world if I died or went mad before the morning came, and I was unable to unbosom myself of my secret. Now, in a few words, what I put before the engineer was this: In the ordinary way you have an engine driving a dynamo which gives out current, this current first lighting lamps, or driving tramcars, and then going back to the dynamo. Why not intercept that current on its homeward path and turn it into a storage battery? It would then be the easiest thing in the world to drive the dynamo by a motor supplied with current from the battery. That is to say, after once starting the dynamo no steam engine is needed, and of course, no boilers or coal. If this was done, power and light could be sold for next to nothing, or we could make such a profit out of our customers as to reduce the rates to nothing, or even pay a bonus! You will not fail to note, too, that I cared nothing for the vast wealth I could have gained by patenting the scheme, but wished only that all the world might benefit without enriching me by a penny.

You will, no doubt, picture to yourself this engineer listening with rapt attention and breathless wonder, as I unfolded my glorious news. You will see him as I ended either throwing himself at my feet in acknowledgment of my genius, or embracing me as a brother. Sirs, your visions are far from the truth. Jealousy—mad jealousy—anger that I should have usurped his province, outshining him on his own ground, overcame this selfish, bigoted man, who, with a torrent of foul abuse, in his nightshirt, thrust me with rude hands into the street. Not content with that, he has so worked on the minds of my fellow-councilors and townsmen that if I do mention the matter I am laughed down as if I were a lunatic.

In the hope and belief that I shall be appreciated at my true value by you and your readers I have written this, and I shall be pleased to allow you to place me on your list of occasional contributors.

U. D. C.

Because of the great difference in the height of water at various seasons, at the generating plant of the city of Geneva, at Chevres on the Rhone, it was necessary to provide some arrangement to give constant speed for the driving of the generators. This problem was solved by building a two-story water tower and placing two turbines, one above the other, on the dynamo shaft. The plant has eighteen sets of dynamos. Three of these are used for the exciters, giving 150 horse-power each. The others, which operate the generators, have a main output of about 1,000 horse-power. Of the output of the plant, about 5,000 horse-power is used by electrochemical factories, 5,400 horse-power for large motors and for the maintaining of about 55,000 electric lamps, and about 1,850 horse-power for the running of small motors.

THE CONSTRUCTION OF TELEPHONE EXCHANGES—XXXIV.

BY A. E. DOBBS.

THE WIRING OF OFFICE BUILDINGS.

In most towns, where an exchange has been installed, the buildings where telephones will be required have already been erected and finished. At the same time if the town is a live one there will be erected in the future a great many new buildings and specially large office structures as the march of improvement goes on that will need all kinds of electrical appliances, and it is the duty of telephone managers, as well as other members of the electrical fraternity, to see that architects make provision for a comprehensive distribution of wires to all parts of the building.

While wiring contracts are not properly within the province of the average telephone manager, yet it is at least to his own interest to help out all branches of the electrical trade, thereby benefiting himself by popularizing the use of electricity in all of its branches and by having proper provisions made for future work, saving a considerable future wiring expense to his own company.

The making of provisions for electric light wiring, owing to the activity of contractors and the stringent rules of insurance companies, is now almost invariably included in all building plans, but provisions for other wires are frequently overlooked, and this is where telephone men should look after their own interests by suggesting that other wires may be as important and necessary as those intended to furnish light only.

As a wiring contractor does not expect to make any profit on the wiring for telephones, district telegraph or call systems, he does not concern himself about their distribution, while builders, thinking that only a few of these wires will be needed—and the wires being small, anyhow, they can be installed at any time—leave them out of their plans. Too late, they find that from two to fifty of these wires have to be placed in all the offices, and that the wiremen, working for himself only, must run them over the surface of walls and ceilings, either bare or in mouldings, that floors must be cut, walls drilled and marred, and the work when done have anything but a sightly appearance. Telephone wiring should be considered as permanent as that intended for electric lights, and in the present age of conduit wiring as neatly installed, and the far-sighted building owner should make provision to extend these cables to every room to outlets conveniently located by precisely the same method now used in the distribution of electric light outlets. One, or at the most two, of these outlets to each room is generally sufficient, as it is an easy matter to locate approximately the various desk positions. It is not necessary that wires should be pulled into conduits, but conduits can be placed in position in order that the various companies, when ready, can fish their wires into place.

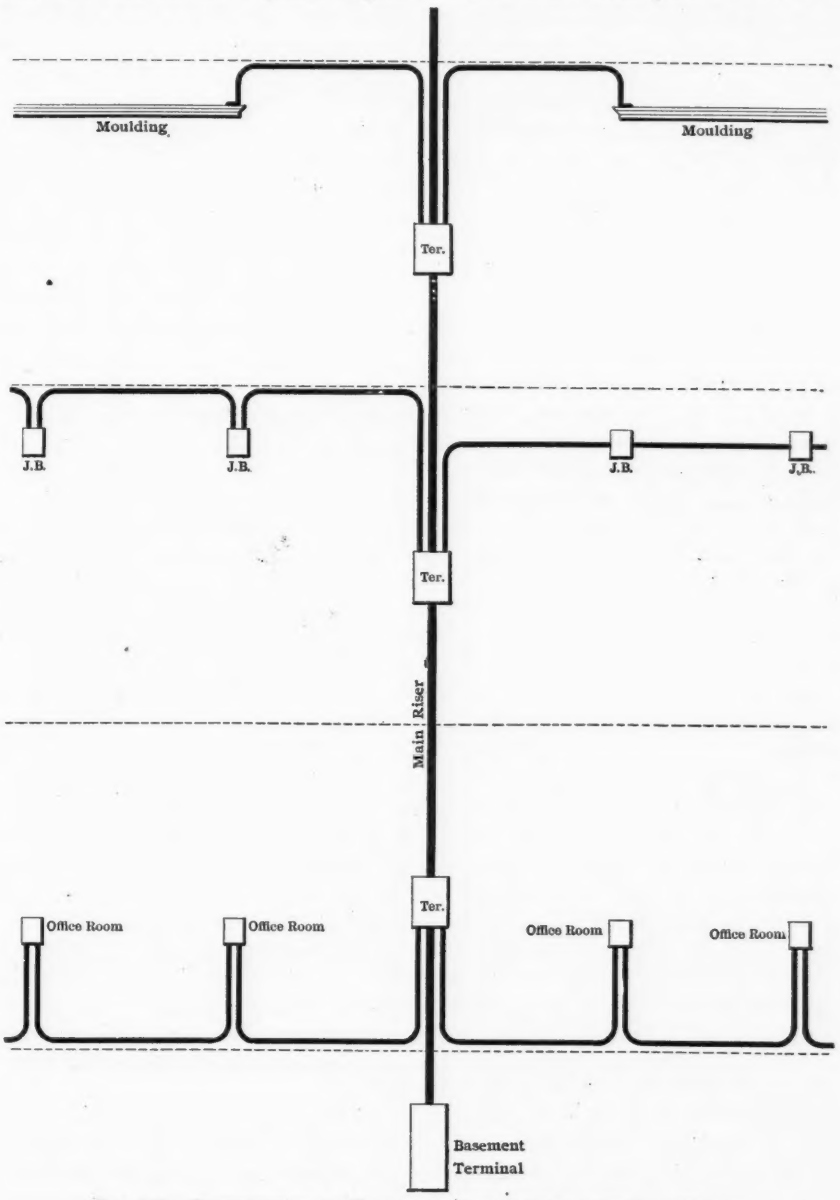


FIG. 145.—DISTRIBUTION OF TERMINALS AND CABLES IN OFFICE WIRING.

In some of the larger cities architects have become educated to this, to a certain extent, and conduits to centres of distribution and picture mouldings adapted to local wiring are used, but even in metropolitan centres, where large office buildings are the rule rather than the exception, there still remains much to be done.

There are several systems of conduit distribution on the market, all of which have been approved by fire inspectors, and as all of them possess merit, the question as to the best can be safely left to local contractors. One thing, however, that should be insisted upon is the use of no conduit to the various offices smaller than three-quarters of an inch internal diameter, which will be large enough to accommodate half a dozen pairs of wires if the pairs are rubber covered or twice as many if No. 20 cotton-braided wire is used.

One of the most substantial, and probably the most commonly used in modern fireproof buildings, is iron or steel pipe either with or without a lining of insulating material on the inside. In some cases, plain ordinary gas pipe is installed, but where this is done a reamer should be passed through the entire length of each section in order to remove any fins or burs that would chafe or cut the wire. The regular conduit, known as "plain,"

has been reamed smooth and coated on the inside with a varnish that prevents a possible condensation of moisture on the inside.

Iron pipe protects the wire against nails or other mechanical injury, and in the event of a cross or short-circuit between the wires prevents the arc from spreading. This conduit is rather expensive as to first cost, and in addition an expenditure of from $25 to $50 for a set of gasfitter's tools is required unless the contract is let to a gasfitter or electrical contractor already supplied with the necessary outfit.

There are several forms of flexible conduit tubes that are put up in coils of 250 feet each which require no special tools beyond a pipe-cutter or a hack-saw.

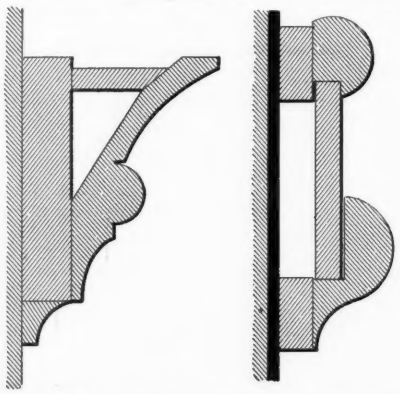
Some of these consist of paper or hard fibre, spirally wound, which is afterward covered with tape and an outside canvas or braid tightly woven and saturated with asphaltum compound. These conduits can be bent around corners, are easily installed and are a fairly efficient protection against dampness, although not suitable for wet places. Most buildings are reasonably dry, however. Another flexible conduit consists of a spiral steel band woven and closely fitted over the outside which also comes in long lengths and is flexible enough for all ordinary corners. Another form of duct sometimes used, but not very desirable, is simply a plain wooden boxing, one or two inches in depth by three or more in width, painted inside and out and extending from the basement to the upper floors with outlets at each floor. This conduit set into the wall and covered with plaster is roomy and convenient, but the objection to it is a possible danger from fire should there be a cross between telephone wires and a high-tension current. The writer has never seen tile duct used as "risers," as these main-feeder ducts are sometimes called, but there is no good reason why, if it makes a good street conduit, it should not be used in the "floor risers" of fireproof buildings as it could be built into the walls, taking the place of portions of the terra-cotta or fireproof brick now used to surround iron columns, or build up walls, and while not absolutely moisture-proof it certainly would be fireproof.

DISTRIBUTION.

It is, of course, unnecessary to say that telephone and electric light wires should not go in the same ducts no matter how good the covering on the wires might be, or that the two classes of ducts should even be kept from all contact with each other.

In the ordinary building the "main," "feeder" or "riser," as it is variously called, extends from the basement to the upper floors with distributing boxes at each floor.

As the owner of the building pays for these conduits the "risers" should be large enough to accommodate all the telephone wires that could possibly be used in the building, for the difference in cost will be very slight, and it is better to err on the side of safety than the other way; it is also just as well to give the wires plenty of room anyhow, for they are then much easier to fish and trace. This riser may be so arranged that the cable from the outside can be brought in from either the basement or the upper floors, as the system may be an overhead or underground one, and at the place where the outside



FIGS. 146 AND 147.—TELEPHONE MOULDING.

cable meets the inside wiring it may be ended in a junction box large enough to hold all the wires of all companies likely to enter the building. If an overhead system, all the wires should terminate in heat coils and lightning arresters, but if underground all the way to the office these may be considered unnecessary, for heat coils only add resistance to the line and are always a possible source of trouble and hence should be regarded as a necessary evil, necessary only wherever the telephone wire is liable to contact with other high-tension wires. Whether fused or not, these wires should be connected to numbered strips so they can be readily found and traced.

From this point on, distribution may differ according to the number of wires in use. If the building is a small one, each company will probably be allowed to distribute its own wires in its own way. If, on the other hand, the building is a large one, cables are often carried up through the building and distributed at the various floors similar to the plans already given for outside cable distribution. In a large building, there is generally a man in charge of the wiring who directs the placing of wires and connections and assigns, and keeps a record of all terminal connections and to whom application must also be made for keys to the various floor cabinets. These floor cabinets or junction boxes are the centres of distribution for each floor, and from these distribution may be made in two ways, the best being, probably, by means of lateral or branch conduits to the various offices, as shown in Fig. 145. By this method the branch conduit extends from the floor terminal through several offices, with a small junction box in each, located at points most likely to be convenient to the occupants from which wires can be led out as desired.

It does not follow that wires passing through these local boxes will terminate there, though wiremen will generally find it convenient to cut their wires at these places and make splices as they fish their way from section to section.

These junction boxes may be located four or five feet from the floor, or they may be located near the ceiling where they are out of reach except from a step-ladder. In the latter case the boxes might be located in one corner of the room and wires passed along the top of a picture or crown moulding to the part of the room desired.

Another method of distribution from the risers much used in office buildings is by means of a moulding run especially for that purpose similar to that shown in cross-section by Figs. 146 and 147. This moulding is from four to six inches in width and extends entirely around every room and the entire length of every hall. As will be seen by the cuts, both mouldings are hollow and contain from two to four square inches of space into which a large number of wires can lay loosely. Wires are carried from the junction box to the top of this moulding through conduit pipe and distributed in the directions desired. This moulding is made of hard wood, and in the offices, not only serves as an ornamental crown border for the wall, but is also used to hang pictures upon, as well as act as a receptacle for wires.

Of the two forms shown Fig. 146 is to be preferred, as it can be left open at the top or at least frequent openings left for manipulating the wires which are passed around the room and dropped vertically down the wall at the exact spot desired.

In the form shown, as Fig. 147, the face of the moulding is generally fastened in place by means of screws which must be removed and the coping sprung out before the wires can be placed. In course of time these screws begin to cut the threads and work loose. The face of moulding also becomes more or less marred by being pried out, which is not the case with the crown moulding shown in Fig. 146.

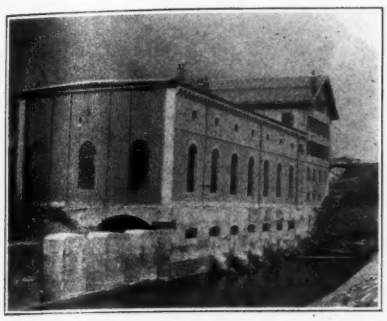
In working the wire into these conduits a long flexible wire or a steel tape made for that purpose is generally used which can be pushed for long distances. These steel tapes generally come in 100-foot lengths.

Transmission of Energy from St. Maurice to Lausanne, Switzerland—I.

Employing the Series System at Twenty-three Thousand Volts.

(By Enrico Bignami.)

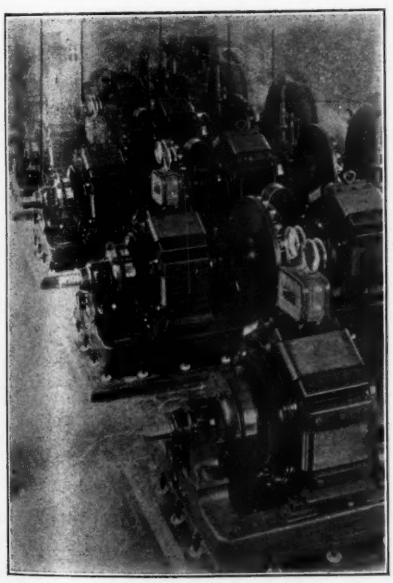
A SHORT while ago the village of Lausanne, one of the small capitals which stretch along the borders of superb Lake Leman, chief town of the Canton of Vaud, and the seat of a renowned university, in-



VIEW OF THE GENERATING STATION AT ST. MAURICE.

augurated the most important transmission of energy which has yet been executed in Switzerland.

The village of Lausanne acquired, in 1898, an hydraulic power of 14,000 horse-power on the Rhone at St. Maurice, distant fifty-six kilometres from the point



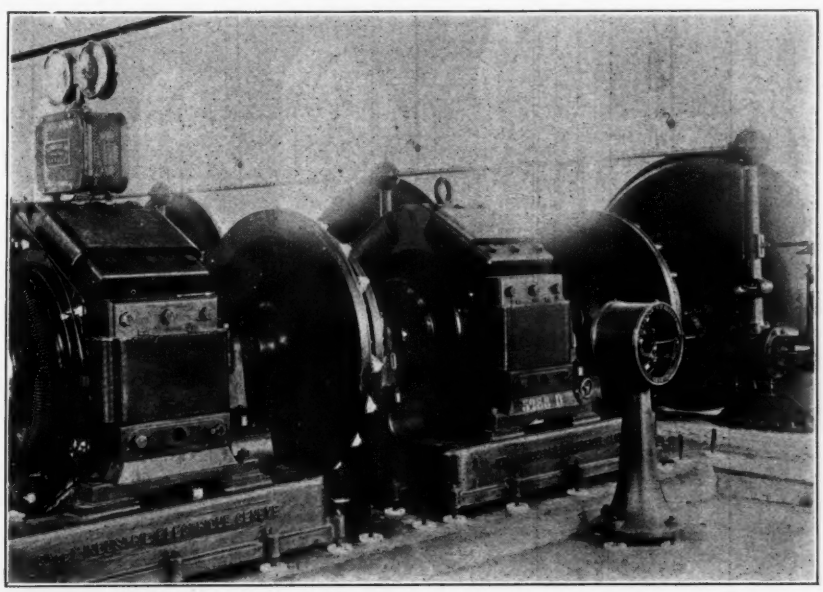
INTERIOR VIEW OF THE GENERATING STATION, SHOWING THE FIVE DIRECT-CONNECTED GROUPS.

of utilization. The project for transmission by electricity was submitted to a college of five electricians chosen from the most competent. These gentlemen conclude unanimously in these terms:

"Your experts, after having studied the project presented for the transmission of energy from St. Maurice to Lausanne by continuous currents and by three-phase alternating currents, do not hesitate to recommend the continuous-current series system. This choice is dictated by the security of the exploitation and the consideration of regulating for light and rests upon the economy of construction.

"The results of these studies show that the three-phase system would cause an increase of the total installation, other things being equal, of 704,000 francs."

The diagram given shows the extreme simplicity of the plant. There are no switchboards. The single apparatus, mounted in a cast-iron column, is a short-circuiting switch (the ammeter and voltmeter for each machine are placed directly on each unit). To stop the group of generators this, on one hand, short-circuits the line, and on the other, the group. To put the generators into service it suffices to start the turbines slowly. They start easily, and the generators excite themselves on short-circuit. As soon as the ammeter shows 150 amperes, the



ONE OF THE GENERATING GROUPS AT ST. MAURICE, SHOWING 1,000-HORSE-POWER TURBINE COUPLED TO TWO CONTINUOUS-CURRENT GENERATORS, EACH GIVING 150 AMPERES AT 2,300 VOLTS.

group is thrown into the circuit, which is accomplished by manipulating the line switch without any sparking, and the load is balanced little by little automatically between the different groups in service. The speed varies with the load and is controlled automatically by a regulator which operates through a common transmission system on the governors of the turbines.

The first section of this work, which comprises the transmission of 5,000 horse-power, was finished at the commencement of 1902. The generator station of St. Maurice includes five turbines, built by Escher-Wyss & Company, each developing 1,000 horse-power, with a fall of thirty-two metres, at 300 revolutions. Each unit drives directly two generators, furnishing together a current of 150 amperes at 4,600 volts, giving at full load of the station a current of 150 amperes at a difference of potential of 23,000 volts. There are also two turbines of 120 horse-power each, driving two small three-phase alternators, giving 3,000 volts at 750 revolutions for service in the locality of St. Maurice.

The line, which is fifty-six kilometres long, single distance, is composed of two cables 150 millimetres in cross-section. These are supported by double-petticoat insulators guaranteed for a tension of 50,000 volts. It feeds, by making a loop of two kilometres, a 400-horse-power motor at the cement factory of Paudex,

then terminates at the station of Pierre de Plan situated to the north of Lausanne. It has been tested by means of current from a special Thury machine of twenty-five kilowatts capacity which generates directly a continuous current at 25,000 volts.

It has been possible with this machine to raise the pressure without difficulty up to 25,000 volts, and this result is so much the more notable in that up to this time 10,000 to 12,000 volts have been attained with difficulty. These results have been more than doubled at a single step by the new Thury dynamo. Without doubt the day is not distant when, by coupling several of these dynamos, it will be possible to study the effects of continuous current at 100,000 volts or more. But even as it is, this machine is very interesting, especially for the study of continuous currents. All the better-known phenomenon of electrostatics can be reproduced by it, charging Leyden jars, attraction and repulsion of light bodies, the production of ozone, etc. One can also drive as a motor an induction machine made of glass plates. All those, and they are not few, who in their youth received in their lessons in physics some notions of electrostatics, and have preserved the memory of a thing of an entirely different nature from galvanic electricity, will at first be disconcerted to learn that there exists only one kind of electricity, but will understand better the reality, by means of the practical demonstrations which this machine offers, than by all possible theories.

The general construction is simple. It is a bipolar dynamo resembling exteriorly the modern alternator with radiating poles, as is shown in the illustration. The field is of sheet iron and revolves within the interior of a ring made of two pieces and constituting the armature. This latter is fixed. The armature coils to the number of forty-eight are imbedded in grooves in the ring and insulated simply by special paper. Each of the primary coils consists of 500 turns of wire one-half of a millimetre in diameter, insulated by silk. This gives 24,000 armature turns, having a resistance of 700 ohms and capable of a normal output of one ampere. The collector is composed of ninety-six segments insulated by air and is also fixed, contrary to those of ordinary dynamos. Two metallic brushes rub on its interior surface and collect the current. As there was some danger to fear that an are would be drawn between the segments of the collector, considering the high difference of potential existing between each of them (500 volts being the average), a small blower intended to throw a strong current of air at the extremity of the brushes has been provided. This blower in practice is not necessary, as long as the output is not greater than three-tenths of

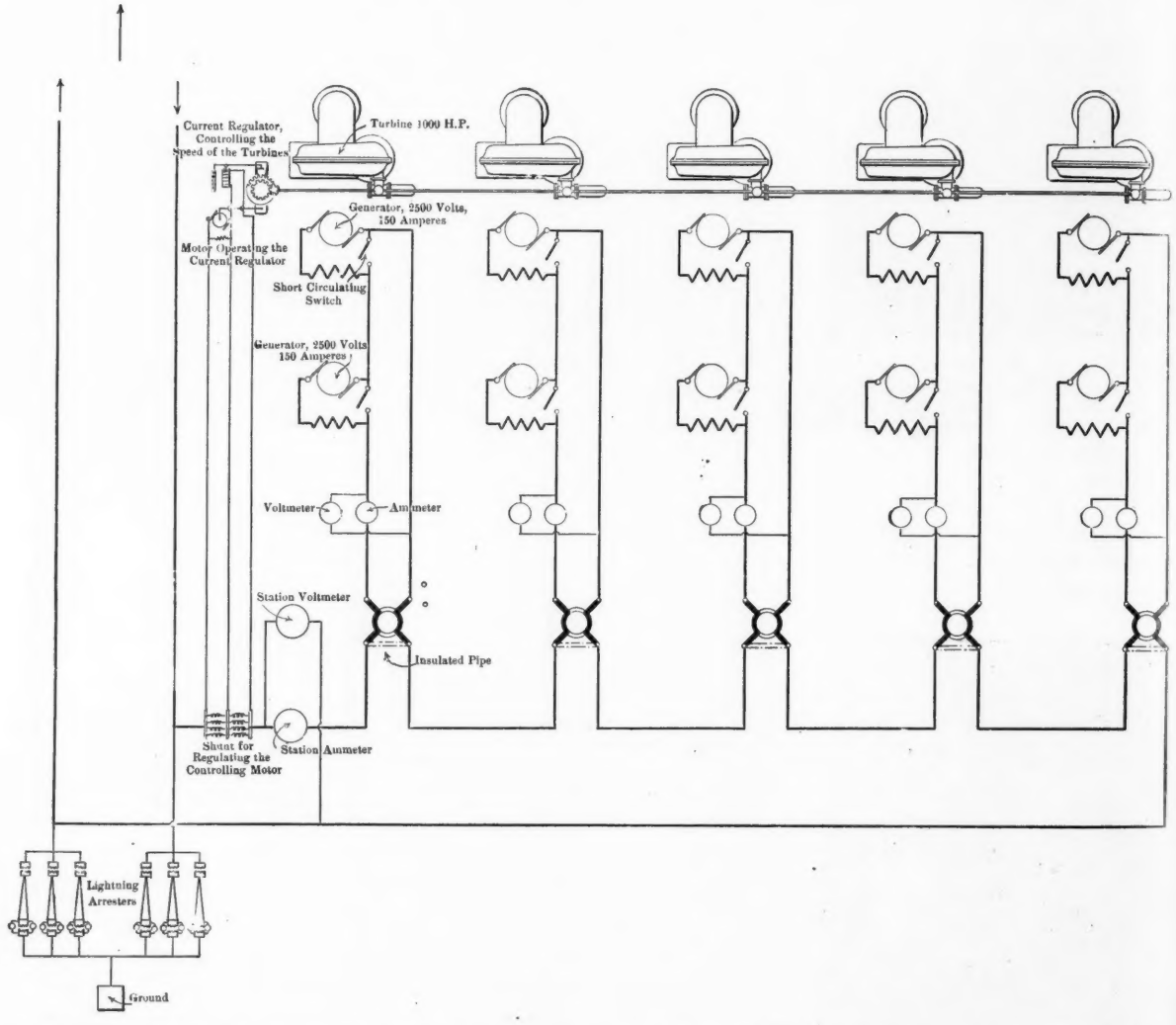
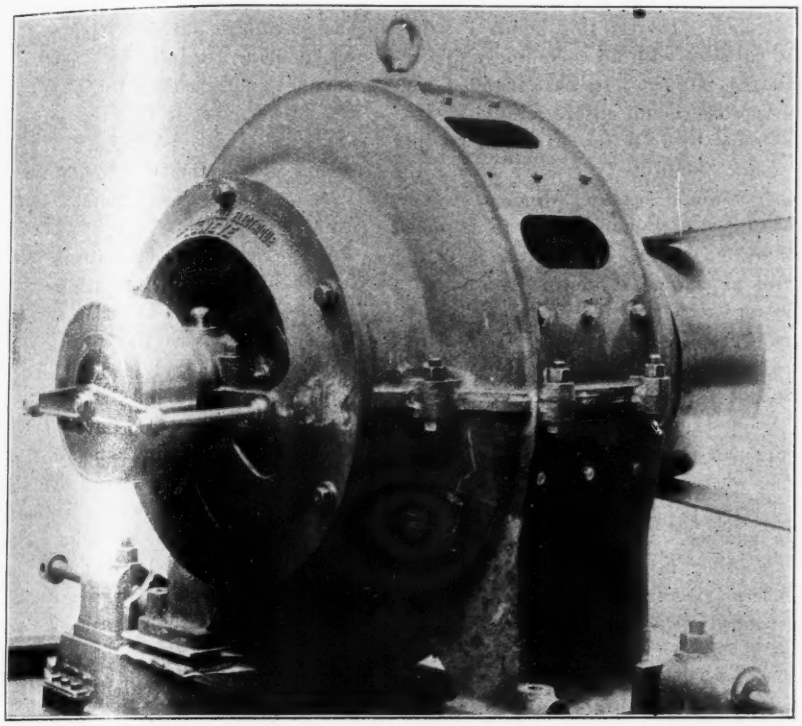
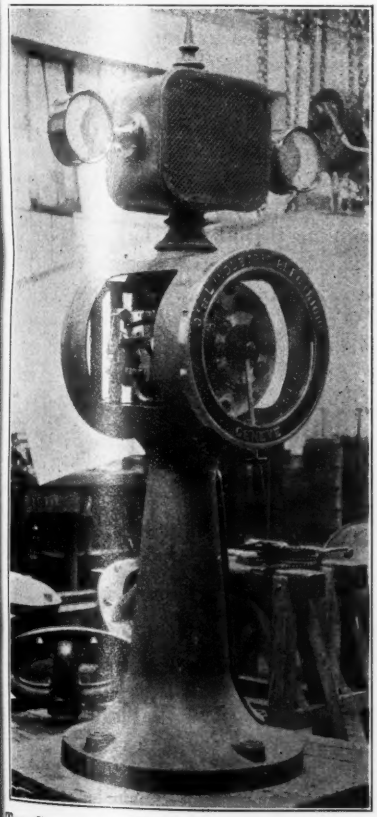


DIAGRAM SHOWING THE ARRANGEMENT OF THE TURBINES AND GENERATORS AND PLAN OF WIRING IN THE GENERATING STATION AT ST. MAURICE.

an ampere, but it is very useful when the output passes one ampere, for then the armature reaction becomes noticeable, the



THURY'S HIGH-VOLTAGE DYNAMO, GENERATING DIRECTLY CONTINUOUS CURRENT AT 25,000 VOLTS.



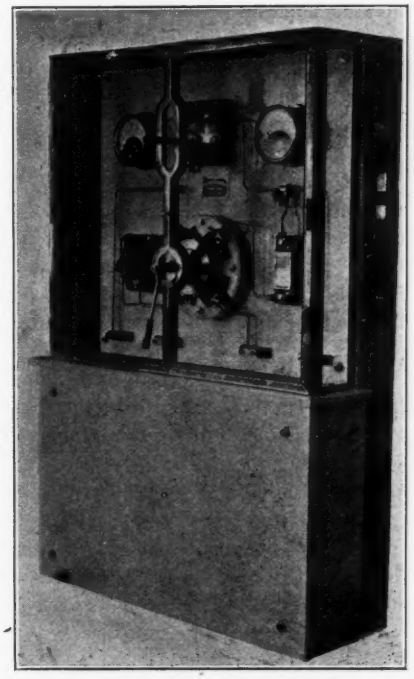
THE CONTROLLING SWITCH AT ST. MAURICE.

more so since from the construction of this dynamo shifting of the brushes is not possible.

Exciting current is furnished by a small separate exciter as for an ordinary alternator. This is carefully insulated from the ground as is also the rheostat for regulating the exciting current.

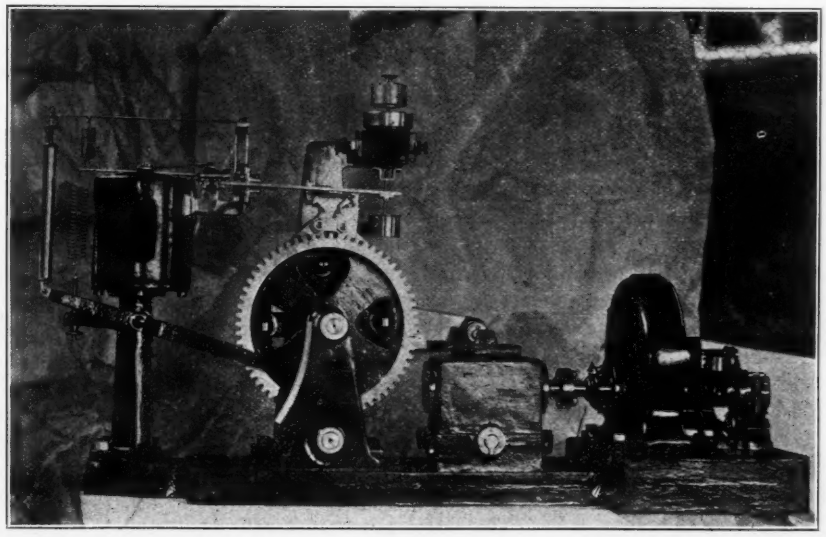
The maximum excitation provided is fourteen amperes at eighty volts, but eight amperes suffices in practice, giving 25,000 volts at a normal speed of 600 revolutions. The normal output available at the terminals is 25,000 watts.

The receiving station of Pierre de Plan a Lausanne at present includes only five series motors, each of 400 horse-power, absorbing at 150 amperes a difference of potential of 2,150 volts each.



ONE OF THE MOTOR-STARTING SWITCHBOARDS AT LAUSANNE.

These motors have small starting switchboards which include a voltmeter, an ammeter, a switch and an automatic cutout. On each motor is mounted a speed regulator which operates by shunting the fields and shifting the brushes.



THE AUTOMATIC CURRENT REGULATOR AT ST. MAURICE, CONTROLLING DIRECTLY THE SPEED OF THE FIVE TURBINES.

At Paudex, where space is restricted, the switchboard is replaced by a cast-iron column which contains all of this apparatus.

THE INHERENT NATURE OF COHERERS.

BY EDWARD P. THOMPSON.

I think I can present evidence to prove that the starting action in a coherer is a spark or sparks produced between the particles of the coherer. A coherer will never operate satisfactorily until it is completely tapped back to its normal condition. Or in other words, the particles which complete the circuit in the cohered condition must be separated before the Hertzian waves will cohere them again. If the particles are separated too far, the Hertzian waves will not cohere them again, unless increased in cohering power.

I have found, and others have noticed the same effect perhaps, that the looser the particles the higher must be the voltage between the Hertzian wave transmitting terminals. If the coherer is close enough to the transmitter, and if the transmitter is powerful enough, the sparking in the coherer is visible in the dark, and the action of the coherer is very strong. At a distance the spark is so small as to be invisible.

I have performed a radically different experiment with the coherer, independently of any distance Hertzian wave transmitter. I have connected a coherer in circuit with a single cell, and broken the circuit. The coherer was so adjusted as to the looseness of particles, that cohesion did not take place when the circuit was broken. Neither did it take place when two or three or four cells were connected in series through an inductance coil. When, however, a fifth cell was added, there was enough electro-motive force to break down the insulation between the particles, and the resistance became reduced. When the insulation was broken down, of course a spark must have been produced. The above related experiments would show that a coherer can not be operated until the electro-motive force of the oscillatory current, produced either by Hertzian waves at a distance or by inductance in a battery circuit—until the electro-motive force is sufficient to produce a spark in the coherer.

I have tested my conclusions by comparative experiments with oil coherers, and even with coherers where the insulation is very thin sheet mica. The only difference is that the electro-motive force must be all the greater when the particles are surrounded by a liquid, especially an insulating liquid like oil. The mica coherer will not operate until the electro-motive force is large enough to puncture the mica and form a conducting spark.

If the starting action of a coherer is due to a spark, then a coherer should be more positive in its action if the particles are very close together, and yet definitely separated. To test this point, I coated the particles with an exceedingly fine insulating powder. It was intended that the powder should ensure minute insulating gaps between the particles, so that a spark would be necessary before the coherer would operate. Such a coherer was tapped back more readily to its initial condition. I am aware that it is not novel to mix an insulating powder with coherer particles. I performed the experiment to be the more sure of a spark-gap. The insulating powder employed was plaster of paris.

A question which arises is whether a spark can produce any motion of a particle, whereby the sparking in a coherer will bring the particles into contact with one another.

In order to answer this question, I made a coherer with only one particle, suspended upon the end of an exceedingly delicate spring, with the particle all but in contact with an electric terminal. A current from a battery sufficient to produce a spark was passed, and a telephone receiver was connected up in circuit. The spark not only attracted the particle to the terminal, but when the circuit was thereby closed the spring pulled the particle away again, and then the action was automatically repeated over and over rapidly, so as to be seen, and so as to be heard as a buzz in the telephone. By having the particle in loose contact, only one cell will cause the action, and the sparking is visible. The telephone acts also as an inductance coil. By doing away with the spring, the particle does not vibrate, but remains cohered to the terminal. Here we have, then, a coherer with only one movable particle, which is at the same time one of the electrodes or terminals of the coherer. Consequently, it seems to be evident that in the ordinary coherer, having loose particles, the action is started by a breaking down of the insulation, the forming of a spark, and the attraction of and coherence of the particles to each other.

It is said that a coherer will lose its conductivity after a few hours. Any power that will correspond to the spring named above will restore it to its normal condition. To let a coherer stand for a few hours, means that the jarring it receives from moving objects decoheres the particles. The mere walking upon the floor will gradually shake the particles apart.

I have performed experiments to show that the local battery current does not pass, unless the particles are in contact or unless the spark conducts the current. The spark lasts but an instant; therefore, the enduring conductivity is due to contact of the particles. Any kind of film will answer, that is thin enough for the length of spark produced. A balsam coherer is objectionable, because the particles are not as easily movable as in an ordinary coherer.

Another experiment illustrates that the coherer is actuated by a spark between its particles. Transmit Hertzian waves only sufficient to reduce the resistance very slightly. Now send stronger Hertzian waves. It will be found that these stronger Hertzian waves would have reduced the resistance more if first applied, than if sent for an after-effect of the weaker waves, which latter undoubtedly closed the spark-gap between the particles. After a coherer is once started, it is difficult to reduce the resistance further by additional Hertzian waves, simply because the spark-gap is destroyed, except that there are shunt spark-gaps, but the oscillatory current would take the easiest path, and would need to be of very high voltage to produce more sparks at the shunt spark-gap. Hence, further experiments were instituted to prove this point. Two coherers were placed in parallel. It has probably been noticed by others that such an arrangement is unsatisfactory. Only one coherer "goes off," and the other will not respond to Hertzian waves until the first is tapped. The one coherer was a shunt to the other. The one having the small spark-gap was operated first, and thereby furnished a reduced resistance for practically all the following oscillatory currents to pass through. I found it impossible to cause both coherers to be operated together, except by what might be termed a very large excess of Hertzian waves from a very high-voltage transmitter. The result is evidence of a spark in the coherer closing a spark-gap in another, and leaving the other coherer a shunt of high resistance.

On the other hand, coherers in series operate together, the same as any two spark-gaps in series.

From the experiments thus far noted, it becomes possible to explain why a particle follows in the path of a spark, and why the force that sends it is comparatively very great. What is the force, when in the presence of air, whether at atmospheric pressure or rarefied? The spark creates a vacuum in front of the particle, and the air behind presses the

particle in the path of the spark. Even in an ordinary vacuum, this force would be enough to move a particle through a very minute distance and cause contact, and, by forming contact, cohesive force would maintain contact until tapped. A coherer operates better in a closed tube than in the open air. The spark forces the air to one side from in front of the particle, producing increased pressure in the tube, and therefore behind the particle. These actions may be made apparent on a large scale, as in the experiment with the movable particle. What is true on a large scale would be true in wireless telegraphy at a range of 1,500 miles.

Let the real transmitter of an oscillatory current be a spark-gap opened and closed, and in circuit with a microphone and inductance coil. Sparks will be heard in the microphone, if adjusted till the sound is heard. These sounds are thunder on a minute scale, or explosions of air by the sparks between the carbon granules of the microphone, which, in this case, is a coherer operated by an oscillatory current such as would be found in an aerial wire in wireless telegraphy. A microphone (or coherer with a diaphragm) would, no doubt, produce sound by the action of very powerful aerial Hertzian waves, which would generate an oscillatory current in the aerial wire, and the oscillatory current would produce sparks in the microphone. I am not referring to the case of a magnetic telephone receiver connected up with a microphone, but to the microphone itself, used as a receiver and producing sound.

Finally, sparks are produced in a coherer, because a coherer is, itself, a generator of weak Hertzian waves, as I have proved by an indirect process. A movable needle point resting very lightly against metal forms a coherer. Moreover, an oscillatory current, however delivered, generates Hertzian waves in such a coherer. It is easily accepted that the Hertzian waves could come from nothing but a spark formed in the coherer.

Should any precaution be taken in behalf of the coherer against injurious effects of the sparking which starts coherers into action? No, it is too insignificant. The local current-sparking, however, is an objection, but this is another matter. Anything which will aid the oscillatory sparking is an advantage. Tapping, for example, assists in forming sparking gaps. Increased electro-motive force at the Hertzian transmitter also assists. Inductance coils properly arranged are an advantage. An elementary coherer for wireless telegraphy may, therefore, be defined as a device having microscopical spark-gaps between freely and easily movable minute conducting particles.

Other practical considerations follow. Whatever diminishes the distance between the particles, and between the electrodes and particles, without at the same time causing absolute contact, will be of great advantage in the action of coherers, because the sparking distance will be diminished. Some force is needed to hold the particles very near one another, and still permit a film of air to prevent contact in the normal condition of the coherer. Such a force is magnetism. I have performed scores of experiments with magnetized particles and magnetized electrodes, and a coherer constructed on this principle seems to throw other coherers in the shade. There is the force of magnetism acting as so much glue to hold the particles continually closer together, and regardless of any exact position of the coherer. One might think at first that the magnetism would itself cause reduction of resistance by cohering the particles. So it does, if too powerful. By placing a permanent magnet near the coherer, it may be moved toward the same until the least Hertzian wave will operate the coherer. Naturally, at first, and before I was convinced of the true nature of coherers, I conjectured that the magnetic field of force was acted upon by the Hertzian wave field of force, the one assisting the other in some very direct way; but there is no reason for such a hypothesis. It is only another piece of evidence that sparks start a coherer into action. The weak magnetic attraction is not sufficient to break down the film of air, but it is sufficient to reduce the thickness of that film to microscopical proportions. The closeness of the particles may, of course, also be adjusted by mechanical pressure, but this is not as reliable as magnetism, for the reason of the absence of attraction or a very desirable form of mild cohesion. The mechanical compression in combination with magnetism produces the happy medium.

Book Review.

"Sketches Old and New." Walter P. Phillips. New York. J. H. Bunnell & Company. Cloth. 250 pages. 5¾ by 8¼ inches. Numerous illustrations.

The author of these sketches is well known to the electrical fraternity, particularly those in the telegraph business. The sketches are well written and have much in them of interest to old-time telegraphers and early students in the art of electricity. The book is supplemented by an address, entitled "From Franklin to Edison," and much other matter of the same general nature.

Apparatus for Measuring Mechanical Equivalent of Heat.

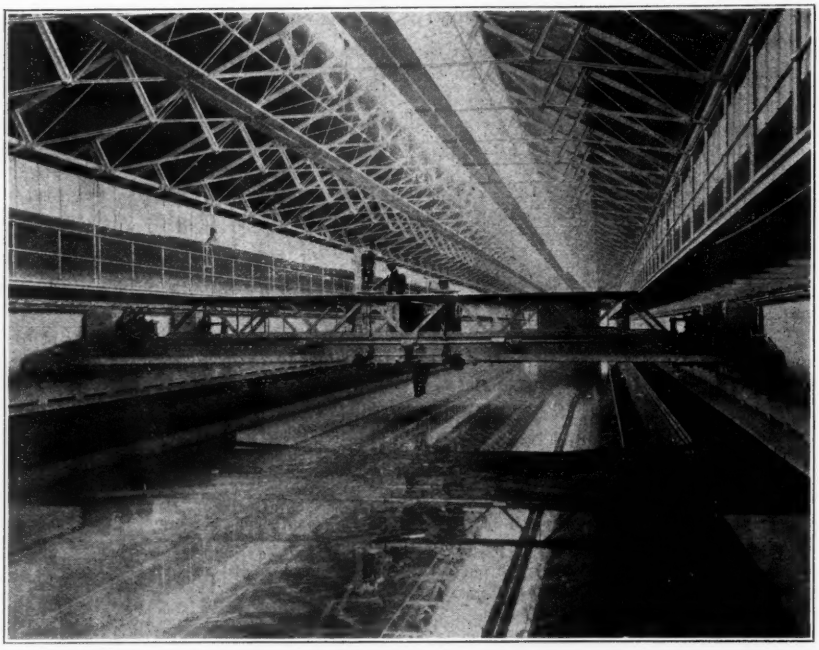
Professor H. L. Callendar has invented a "simple apparatus for measuring the mechanical equivalent of heat." A cylindrical brass calorimeter is rotated by hand about a horizontal axis at a moderate speed. Unequal weights are suspended from the ends of a belt slung over the cylinder. Stability of equilibrium is secured by making the two halves of the belt of different materials and connecting the side having the smaller coefficient of friction to the larger weight. The weights are adjusted by trial to suit the friction of the belt, and may be varied within wide limits, provided that the ratio is kept nearly the same. The advantages of the methods are? (1) The friction is very nearly independent of the speed; (2) the balance is automatic, the belt immediately adjusts itself to any change of load or friction; (3) there is no change in the thermal capacity of the calorimeter with change of speed or load; (4) there is no pull or bearing friction to introduce errors; (5) there are no forced vibrations, and no dashpot is required; (6) the actual torque may be measured statically if desired. The rise of temperature is observed by means of a bent platinum thermometer inserted through a hollow axle on one side. The external loss of heat can be eliminated by Rumford's compensation method, or by performing two experiments with different loads on the belt. The motion of the surface of the calorimeter eliminates the effect of draughts and convection currents, so that the heat loss is much more regular than if the surface were at rest.—*Mechanical Engineer* (London).

Professor William H. Burr, of Columbia University, and one of the engineers of the Isthmian Canal Commission, in an article in the August number of *The Popular Science Monthly,* compares the Panama and Isthmian Canal routes and thus summarizes the possibility of danger from volcanic disturbances: The recent volcanic eruptions on the Island of Martinique indicate a possible danger to the Nicaragua Canal, should it be built, from the living volcano of Ometepe in Lake Nicaragua about ten miles from the land line. That there is some danger is beyond question, but it is very remote. There is no evidence to show that a canal or canal structure ten miles distant from Mount Pelee would have been injured by its recent eruptions, although navigation might have been interrupted for a short time. It is an open question, therefore, whether Ometepe in most violent eruption, even, would injure the Nicaraguan Canal, although danger would exist. On the other hand, as there is no volcano within about 175 miles of the Panama route, that route would be free from all danger of volcanic eruption.

Electrical Equipment of the Washington Navy Yard.

Congress, during the recent session, appropriated $100,000 for purchasing a site for an addition to the plant of the Washington Navy Yard. The navy yard at present covers forty-five acres, but the new addition, which will extend westward, will almost double this and will furnish room for several new buildings.

In addition to the above, extensions of the present plant are now being made, one of them being a very large brick structure, the machinery of which will be operated electrically. The use of electricity for power at the navy yard is steadily gaining ground, and it is safe to say that in no very long time it will drive all the machinery there, as well as do all the lighting. In the latter particular it is now employed for about 400 arc lamps and 4,000 incandescents. The wires in the yard are in underground conduits, and the system is in a most satisfactory condition.



The Model Testing Tank, Showing the Towing Carriage.

Within the last two years about $100,000 has been spent on the electric plant, and the change thus brought about has met with general approval. Motors are now employed in nearly all the shops, and in some they have completely supplanted steam power. The shops in which motors are exclusively used are secondary mount, tool, gunner's workshop, breech mechanism, cartridge case, seaman gunner's, erecting, miscellaneous shop and driving galleries of gunshop.

In the shops where the motors operate shafting the former are high above the galleries and so are out of the way of all other machinery. In one shop—the seaman gunner's—the motors are directly connected, which method in some respects is better than operating a series of machines by one shaft, which, to operate even a single machine, must be kept in motion.

The direct-connected motors are employed principally for small lathes, shapers and milling machines, and, in some cases, are mounted on the machines; in others they are attached lower down and belting is used. These motors run from one to four horse-power each.

All excepting one of the carrying cranes in these shops are run by electricity, there being four motors to each. The single exception is the 110-ton crane in the big gunshop. There are fifteen of these cranes which vary in motor-lifting power from ten to twenty-five horse-power.

The power for the electric machinery at the navy yard is supplied from one of the best equipped, though not the largest, of the plants in the District of Columbia. Chief Electrician W. G. Reed has left little undone that could add to the excellence of his department. At present one engine, built by the General Electric Company, and comparatively recently installed, is doing the work of the plant. It well represents modern practice in machine design, for so evenly is it balanced that a cent piece placed on edge on the cylinder is not disturbed sufficiently by the jar to be thrown down.

One generating set consists of 600-horse-power McIntosh & Seymour engine directly connected to a 400-kilowatt General Electric, two-wire, 230-volt generator. One 80-kilowatt set consists of one 125-horse-power Ball & Wood engine directly connected to 40-kilowatt, 115-volt General Electric generator, and two generating sets consist each of one 300-horse-power, cross-compound Ball & Wood engine, each engine directly connected to a 210-kilowatt, 115-volt General Electric generator. All are connected on the Edison three-wire system, the 400-kilowatt generator being between the outside bus-bars.

The every-day load of 3,600 amperes is obtained through use of the two 175-horse-power boilers, but the whole output of 1,500 horse-power is got by aid of boilers in the ordnance department of the navy yard.

Among the features of the electric plant of the big war-material factory is its oiling system. This is partly located in a room on the second floor of the building, where are a number of oil tanks equipped with filters. The oil is strained and filtered through water, then passes by gravity to the engines, the overflow pumped back to the tanks of the storage room. By this method there is no unnecessary waste, and since its installation the consumption of oil has been reduced from four to five barrels a month to about four barrels in seven months.

Another interesting feature of the navy yard's electrical equipment is the fire-alarm system. The apparatus is of the latest improved Gamewell pattern, and is mainly located in the office of the chief electrician. The yard is divided into five stations, with an alarm box at each. In each shop there is a six-inch gong, and at the central station an automatic electric signal box, having face-slots for exhibiting the number of any station of the system.

The time bells of the yard also are operated from the central station.

In going through the immense shops of the Washington Navy Yard one is struck with the wilderness of belting which runs up to the pulleys on the long power-shafts. This, of course, as suggested above, could be remedied by direct-motor connection and thus afford more working space.

In the shop where the small work is done magnetic bed-plates are used for holding the work in place.

There is one other service at the Washington Navy Yard in which electricity plays a prominent part, though it is not connected with the yard's electric plant described above. This is the model testing tank. Here the finished model—which is of wood and usually about twenty feet long—is taken to the tank,

a brick building 500 feet long and fifty feet wide, and is placed in the water and attached by a long rod to an electrically operated carriage, having four motors directly connected with the running gear. The carriage spans the tank and runs upon tracks arranged at both of its sides and extending nearly the full length of the building. The carriage tows the model, and while this is being done electric apparatus on the carriage automatically registers the tractive effort and the action of the model at various speeds.

The crane (towing carriage) in the model testing tank is operated by motors direct-connected to the axles; there are eight wheels and four motors, the latter aggregating an output of 300 horse-power. This is obtained from a near-by power-house—which also supplies some other places in the navy yard, notably the model-making shop—and has an output of about 1,400 horse-power.

When at full speed the model-tank crane travels at the rate of twenty knots per hour, but can be operated at the low rate of one-tenth of a knot per hour.

J. E. P.

LETTERS TO THE EDITOR.

An Old-Time Telegrapher.

To the Editor of the Electrical Review:

There are a number of the readers of the Electrical Review for whom tidings of an old acquaintance will possess more than passing interest.

Among the old telegraphers the name "Bogy" is a synonym of mysterious disappearances and ceaseless unrest. He is the veritable "Wandering Jew" of the telegraph profession. Now here, now there, never in one place long, but certain to turn up somewhere.

And so I was not surprised when one day, not long since, he floated in upon me in Dallas. The last time I saw him, previous to this visit, was in 1884, when he attended the meeting of the Old Time Telegraphers' and Military Telegraph Association at the Murray Hill Hotel in New York.

Measured by years Bogardus's life has not been a long one, but he appears to be the oldest tradition of which there is any trace in the history of telegraphy.

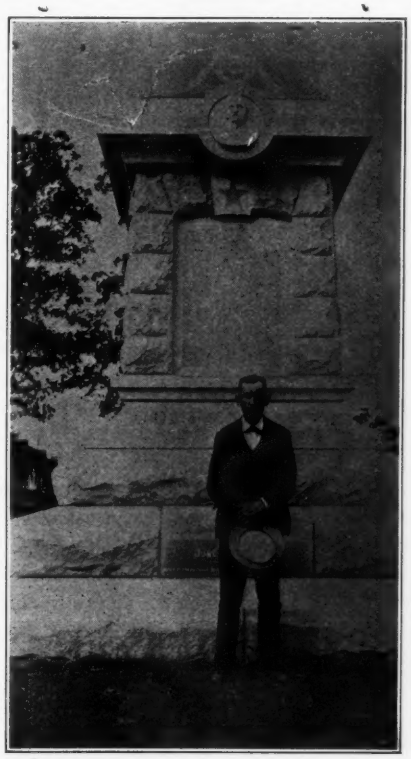
I think he told me he took his first office in 1852, when he was sixteen years of age. This would make him sixty-six to-day and, considering everything, he carries these years well.

There is no record as to when the spirit of restlessness seized upon our friend, nor is it just clear why this man, who was an expert operator and much above the average in intelligence and address, who has associated on friendly terms with Edison, and others occupying high positions in the world's work, should have for so many years been a wanderer on the face of the earth.

I think I have heard that a domestic affliction, involving the loss of wife, child and mother all in a very short space of time, first started him on the career he has so long followed. In any event, "Bogy" stands out a lonely and pathetic figure.

I hope you will find space for this picture of "Bogy," taken in front of the Confederate Monument in Dallas, on June 6, 1902.

To those who know him it will be proof that he still lives, and to those to whom an



Bogardus, an Old-Time Telegrapher.

acquaintance with "Bogy" is yet an anticipated pleasure it will be a credential commending him to their kindly consideration.

Frank B. Knight.

Dallas, Tex., July 19.

Standardization of Advertising Literature.

To the Editor of the Electrical Review:

Would you care to join hands in a crusade for the standardization of advertising literature?

Probably the greatest inconvenience experienced by those obliged to retain the numerous catalogues which are received is caused by the fact that there are so many different sizes. There is really no good argument in favor of this large variety of shapes and forms other than, perhaps, the artistic effect which is occasionally secured.

For flyers the size should be made three and one-half inches by six inches, but when it comes to standard catalogues where they cover lists, code words, etc., that are expected to be referred to from time to time and must be filed for reference, it is extremely essential that the six-inch by nine-inch size of the book be considered if the best results are to be secured.

We have on file in our office about 3,500 catalogues and pamphlets, and I find that there are more than 500 different sizes. It is self-evident that to file these catalogues so that they will be convenient for reference is a most difficult matter, and if they are not filed so that they can be conveniently referred to the manufacturers represented are the losers. It would seem, therefore, that this fact alone would cause manufacturers to think well before they decide to use a mongrel size when making a catalogue.

Three sizes have been decided upon by, I believe, a committee appointed by the steam railroads a number of years ago, namely, three and one-half inches by six inches, six inches by nine inches and nine by twelve inches. If all literature conformed to these three sizes the files of those who are obliged to keep them would be vastly improved, and it would facilitate the finding of data concerning any particular product to an incalculable extent. The saving in time alone would be a very large item. Many times, owing to the fact that catalogues have not been properly filed, days are sacrificed writing for a duplicate copy and an order is lost to a manufacturer that would have otherwise received the business had his literature been available.

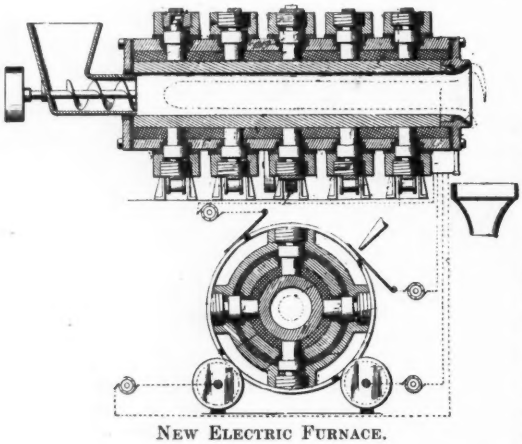
Since coming with this company I have rigidly adhered to standard sizes for all publications. I have never had occasion but in one instance to use the nine-inch by twelve-inch size. All of my bulletins are made six inches by nine inches, and flyers have been three and one-half inches by six inches. These two sizes, when proper attention has been given to the preparation of cuts, would serve almost any purpose. Of course there are cases where perhaps the nine-inch by twelve-inch size would be the more desirable, but at any rate there seems to be no good excuse for departing from these three sizes.

I believe that if the trade press of this country would take the matter up vigorously through their editorial departments and by drawing the attention of manufacturers to the subject in various ways it would finally result in standardizing this class of literature, and the gain to manufacturers, both to the seller and to the purchaser, would be very great indeed.

Frank G. Bolles,
Manager Foreign Sales,
Bullock Electric Manufacturing Co.
Cincinnati, Ohio, July 16.

Electrical Patents

Mr. Hudson Maxim, of Brooklyn, N. Y., has invented a new electrical furnace designed especially for treating highly refractory substances. With this object in view, the invention consists in a revoluble electric furnace through which the material to be treated is advanced in a continuously moving stream and subjected to a progressively increasing temperature from the point of entrance to the furnace to its point of exit therefrom. The furnace is in the form of a revoluble cylinder formed of a steel shell having a fireclay lining within which is a centrifugally maintained auxiliary protective lining or bed that is a conductor. A plurality of radially disposed electrodes pierce the walls of the furnace and engage the inner lining, the outer terminals of the electrodes carrying segmental rings against which suitable contact brushes bear. These brushes are so arranged that they engage different segments of the rings, and each brush is connected to a separate source of electrical energy. The material is fed to the surface from a suitable hopper having a worm in its lower end. The inner lining forms a common electrode along which a constantly increasing electric current secured from the successive series of electrodes passes, and thus a very high temperature is obtained, which temperature increases toward the discharge end of the furnace.

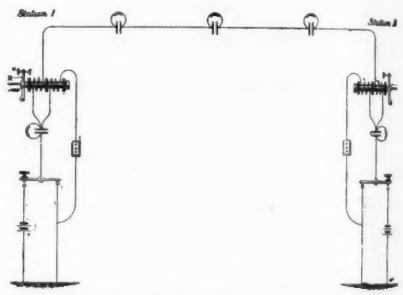


NEW ELECTRIC FURNACE.

Two residents of Solothurn, Switzerland, Messrs. Jacob Fischer and Hermann Schneider, have just obtained a patent in this country on a novel coupling for conducting wires. The coupler consists of a flexible sleeve of coiled wire, this sleeve being oblong in cross-section, and helically twisted, the terminals of the wire projecting beyond the opposite ends. When the coupling is applied to two wires or conductors which are to be connected, and the ends are turned in opposite directions, thereby enlarging the sleeve so that the ends of the wire can be inserted side by side within the interior thereof. Upon releasing the ends, the coil attempting to assume its normal position grips the conducting wires and tightly clamps them together by the torsional strain.

NOVEL COUPLING FOR CONDUCTING WIRES.

An improvement in the construction of telegraph lines which has been patented by Mr. Chas. E. Fritts consists in avoiding, preventing or lessening inductive resistance, such as static charge and retardation. By constructing or dividing the line into sections according to certain principles and electrically connecting the terminals of the adjacent sections to the opposite terminals or armatures of suitable electrical inductive devices, which may be condensers or equivalent apparatus, a composite and organized line is formed having the required length and properties. It further consists in connecting the opposite plates of each of the condensers with each other through a conducting medium, which offers so great a resistance to electric currents of the strength employed for telegraphic and like purposes as to afford a sufficient length of time for the passage of a given impulse therethrough to allow that impulse, when received at one plate of the condenser to be transmitted by induction to the opposite plate and to act upon the next succeeding condenser at the remote terminal of the succeeding section of the main line before the residue of said impulse or charge shall have traversed the artificial resistance and neutralized the opposing residual charge upon the opposite plate of the condenser. The accompanying drawing illustrates the invention. This is a diagram showing the organization of the main line and the arrangement of the apparatus which may be used at the terminal stations in connection therewith. Referring to this, the main line is divided into sections, preferably of such relative lengths that the electrostatic capacities of all the sections shall be approximately equal. Interposed between the adjacent terminals of each of these sections is placed a condenser, to the opposite plates of which are connected the corresponding terminals of the line sections. The greater this capacity per mile the shorter the sections should be, other things being equal. The actual length of the wire or cable in each section will therefore depend largely on its nature and construction and the purpose for which the line is intended, which will be well understood by those versed in the art. A main line constructed in accordance with the principles of the invention may, by proper adaptation, be used in connection with any kind of transmitting and receiving apparatus and with any kind of current. Fifty-one claims are made in this patent, of which the following seem to be the essentials: An improved construction and arrangement of conductors and apparatus for telegraphic and like purposes, consisting of a composite and organized main line composed of two or more non-inductive and non-retarding sections inductively connected together in series by condensers. A main line for telegraphic and like uses, made non-inductive for a given work or speed. A composite and organized main line for telegraphic and like uses, consisting of the combination of two or more non-inductive and non-retarding sections of suitable conductor or cable; inductive devices connecting said sections in series and adapted to transmit signals or impulses from one section to and over the next one, in either direction, without mechanism or moving parts, but by induction alone.



CONSTRUCTION OF TELEGRAPH LINE TO AVOID STATIC CHARGE AND RETARDATION.

The New York State Independent Telephone Meeting.

First Meeting at Rochester a Stormy One—Two Organizations Effected, but Probably Will Unite Later.

IT IS unfortunate that factional feeling should have arisen, through the desire to control the independent toll-line service of the state of New York, at the first meeting of the independent telephone men of New York state held at Rochester last week.

The excellent character of the gentlemen present and the deep sincerity of purpose was a noteworthy feature of the meeting to the mind of the representative of the ELECTRICAL REVIEW who watched the proceedings, and yet these facts only heighten the misfortune of the inharmonious conference for the reason that the points of differences were such that men of their standing should have quickly arbitrated.

It is believed, however, that no real injury has been done the cause of independent telephony in New York state and after an *amende honorable* has been exchanged between the warring factions a better unity will result than might have been otherwise the case. One independent telephone organization in New York state is desirable for the growth of all concerned—two organizations would be detrimental. It is believed that mutual concessions will be made and that the two New York state independent telephone associations will merge amicably into one organization for peaceful ends.

THE PROCEEDINGS.

Between 90 and 100 men, representing the independent operating telephone exchanges of New York state, met in the Court House, at Rochester, July 25, and because of the different sentiments as to officers, largely due to the desire for the control of toll-line service, perfected two separate organizations.

For one of these associations the following officers were elected: President, G. R. Fuller, Rochester; vice-president, Mr. Homer Hendrickson, Albany; second vice-president, Mr. Boyd McDowell, Elmira; secretary and treasurer, Mr. C. O. Harris, Rochester; advisory board—Messrs. S. B. Larson, Niagara Falls; J. S. G. Edwards, Johnstown; J. S. Brailey, Jr., Utica; Edward Davis, Troy; F. N. Potter, Jr., Syracuse; C. D. Vernon, Cortlandt; W. B. Brainard, Saratoga, and E. L. Barber, Rome.

The other organization elected the following officers: President, Mr. Martin Carey, Buffalo; vice-president, Mr. C. E. Stinson, Rochester; secretary, Mr. Charles H. Flood, Ithaca, and treasurer, Mr. F. E. Lyford.

The New York State Independent Telephone Association was incorporated July 26 with the Secretary of State under the provisions of the membership corporation laws.

Papers certifying to the incorporation of the New York State Independent Telephone Association, which is backed by the Frontier Telephone Company, it is said, were filed on July 26 with the county clerk of Erie County.

The meeting had been called for the purpose of forming a single cooperative organization for united effort in advancing independent telephone developments, and especially for aiding the growth of long-distance telephone service. At the calling of the meeting to order it was immediately evident that deep rivalry existed between two factions present. One of these factions was known as the Hubbell syndicate with which is allied the consolidated interests, the new Frontier Telephone Company, of Buffalo, the Everett-Moore interests and some other related toll telephone organizations. In opposition to this faction was the Rawson syndicate, which is now operating toll-line service in western New York, around Lockport, Niagara Falls, Middleport, etc. The conditions which have been rapidly developing during the past few months for the further division and control of the state telephone service were the cause of the dissensions.

This split precipitated a bolting of one faction after the friends of the other had partially secured the temporary organization. It is believed, however, that these conditions are of such a nature that a reconciliation will be effected and the two associations be merged into each other; in fact the ELECTRICAL REVIEW is in a position to state that these difficulties at the moment of this writing are practically adjusted, and that before this publication appears the consolidation is likely to be complete.

The men of Rochester who had been largely instrumental in calling the meeting entered the convention hall with the belief, which perhaps was not unwarranted, that one of their own city would be chosen at least for temporary chairman, as they considered it the custom to select a local representative in cases of this sort to act until a permanent chairman is elected. A few minutes after ten o'clock Mr. William B. Wright, of Buffalo, allied with the Carey faction, arose on the speaker's platform, rapped for order, and said, "I nominate Mr. Carey, of Buffalo, as chairman of this convention."

Shouts of protest were echoed by a number of men present, and Mr. George R. Fuller, of Rochester, was then elected by the opposing faction. This brought out cries of derision from the partisans of Mr. Carey. Succeeding this Mr. Carey was declared elected, at which point Mr. Wright left the platform in favor of Mr. Carey. All this resulted in the joint occupancy of the speaker's table by Mr. Carey at one end and Mr. Fuller at the opposite. For over an hour a scene of disturbance existed. At one time Mr. Carey began the reading of a list of committees. "Where did you make that list?" shouted a voice. At this moment Boyd McDowell, of the Elmira Telephone Company, produced a letter in which the Home Telephone Company, of Jamestown, offered to pay the expenses of a delegate to the convention. Judge Smith accused the Hubbell-Carey faction of following this method for "packing" the convention. Mr. Carey finally invited all those in sympathy with his movement to remain, and Mr. J. S. Brailey, Jr., of Utica, arose to ask all who were opposed to go to Powers Hotel. This resulted in a body of the men returning to Powers Hotel, and in consequence the two separate organizations were effected.

These organizations were, on the following day, incorporated as noted above. In the certificate filed of one of these, the objects stated are "the protection of all independent telephone interests within the state, the standardizing of the equipment and the establishment and maintenance of a bureau of information for the benefit of members of the association." The intentions as expressed in the certificate of incorporation of the other organization are as follows: "To promote the interests and welfare of the independent telephone business, collect and diffuse accurate and reliable information in regard to independent telephone companies, to secure freedom in said business from unjust and unlawful exactions, to settle differences between members and promote a larger and more friendly intercourse between the men engaged in the independent telephone business."

Beyond the making of the two organizations no further matters came up for discussion, though it is believed that the committees acting for the two factions will be successful at an early date in reaching an understanding for a consolidation.

Talc and Soapstone.

Talc is a very common mineral, and in small quantities is widely distributed. It is found in considerable variety in nearly every state along the Atlantic slope, the deposits of best quality being in New York and North Carolina. The New York talc is used almost exclusively as a filler in the manufacture of paper; most of the North Carolina talc is ground to a powder and used in the manufacture of toilet powders; and the talc mined in Virginia is used for the most part in the manufacture of washtubs, laboratory zincs, stove bricks, etc. The other states that have produced talc or soapstone are New Hampshire, Vermont, Massachusetts, New Jersey, Pennsylvania, Maryland, Georgia and California. A large part of the soapstone mined in these latter states is ground and is used for various purposes, as paint, paper filling, lubricants, etc.

The North Carolina talc deposits are found in Swain and Cherokee counties, and the lower grade deposits of More county are also extensively mined. The Massachusetts talc deposits are located near Dalton, Berkshire County. In Warren County, New Jersey, a soapstone vein has been found, which outcrops across the river also, on the Pennsylvania side, in the vicinity of Easton, Northampton County. In Maryland talc deposits have been worked in Howard County, and soapstone of sufficient purity for grinding is reported near Westminster, Carroll County. The Virginia deposits are, for the most part, of the steatite variety of talc, most of it being used for manufacturing washtubs, etc.; a fibrous talc has been obtained in the vicinity of Wiehle, Fairfax County, and a deposit of soapstone, of good quality, is reported from Oakland, Louisa County. The Georgia talc has been mined chiefly in Murray County, a little east of Dalton, and a deposit of white talc is reported near Ballground, Cherokee County, which will probably be worked during 1902. Soapstone is found at Catalena Island, Los Angeles County, California, some of which is suitable for grinding, and talc has recently been discovered near Lindsay, in Tulare County.

Talc is employed in the arts in two distinct ways—as powdered or floured talc, and as sawed pieces of various sizes and shapes. The flour talc is used as a base for fireproof paints, for electric insulators, in boiler and steam pipe covering, for foundry facings, in the manufacture of dynamite, in the manufacture of wall papers, to give them a glossy appearance, in the manufacture of various toilet powders, for dressing skins and leather, and as a base for lubricants and for many cheaper soaps. The greater part of the soapstone mined is used in the manufacture of hearthstones, as linings for furnaces, for cupola and converter linings in many steel works, for laboratory zincs and ovens, for laundry tubs and slate pencils, to a limited extent in building, and is extensively used in the manufacture of soapstone griddles, which have been found very satisfactory as they can be used without grease.

The production of talc in the United States in 1901, exclusive of the fibrous talc of New York, was 28,643 short tons, valued at $424,888, as compared with 27,943 tons, valued at $383,541 in 1900, an increase of 700 tons in amount, and of $41,347 in value—the largest proportionate increase in value being due to the production of manufactured articles from the Virginia soapstone.

The production of fibrous talc in St. Lawrence County, New York, is usually more than double that of all the other states together, although the value is nearly the same. Its principal use, due to its fibrous character, is for the particular purpose of paper-making. The production in 1901 was 69,200 short tons, valued at $483,600, which is an increase of 5,700 tons in amount, and a decrease of $15,900 in value, as compared with a production of 63,500 short tons, valued at $499,500 in 1900.

At the present time but little talc is imported into the United States, and the importation is very irregular, the imports for 1901 being 2,386 short tons, valued at $27,015, as compared with 79 short tons, valued at $1,070 in 1900, and with 254 short tons, valued at $3,544 in 1899.

A "Technolexicon," or technical dictionary, is to be published by the Society of German Engineers. The editor, Dr. Hubert Jansen, Berlin (N. W. 7), Dorotheenstr. 49, is anxious to include in the dictionary all technical terms used by French, German and English engineers, so that the dictionary shall contain equivalent words and expressions in each of the three languages. Collaboration is invited from societies, individuals and engineering works. The editor would be glad to receive technical catalogues, price lists, handbooks, or list of words and terms for which correct renderings can not be found in ordinary dictionaries. The work will be so useful when ready that all who are able to contribute to its completeness should do so.

Engineers' Outing.

The annual outing of Rhode Island No. 2 National Association of Stationary Engineers, of Pawtucket, R. I., was held on July 27. The meeting took place on the grounds of the Warwick Club, a beautiful spot on the west side of Narragansett Bay. A formal reception was held at the Narragansett Hotel, Providence, from 9 to 10.30 A. M., when special electric cars were in attendance to convey the party to the beautiful residential suburbs of Providence, along the shores of Narragansett Bay to the club grounds, where games were participated in until 1.30 P. M., when a bountiful dinner was served.

An Electrochemical Journal.

Announcement is made that the publication of a journal, to be known as the *Electrochemical Industry,* will be started this fall, with Dr. E. F. Roeber as editor, with whom will be associated as regular contributors Professor J. W. Richards, Mr. Carl Hering and Mr. C. J. Reed. The journal is to be devoted to the broad field of the science and applications of electrochemistry and will undoubtedly prove a valuable addition to our scientific and technical literature.

A comparative study of the permeability of living and dead animal membranes by measurement of the electrolytic resistance has recently been made by Mr. G. Galeotti, and the results are published in *Lo Sperimentali, Archivio di Biologia norm. e patol.,* vol. lvi. The living membranes were first investigated, and then after remaining in chloroform vapor for some time were again placed in the electrolytic cell and the resistance of the solution measured as before. Various salt solutions were employed, the strengths of these being in the majority of cases one-tenth normal. The author finds that the resistance of membranes, which in the animal body separate solutions of different nature and concentration from one another, is ten to forty times greater in the living condition than when the membranes are dead. The resistance of membranes, which have no functions of this character in the animal system, is, on the other hand, unaltered by the action of chloroform vapor. The conclusion is drawn that membranes of the first class, for example, from the cæcum of the rabbit and the bladder of the turtle, behave as semi-permeable membranes in the living condition, but this semi-permeability is lost when the cells are dead. Membranes of the second class, on the other hand, act simply as diffusion membranes, and the permeability of these is the same whether living or dead.—*Nature* (London).

Marconi Inventions.

The publication in the London *Saturday Review*, that the official journal of the British Patent Office contained a brief notice to the effect that Mr. William Marconi had filed, on September 10, 1901, a patent in his own name for his invention, and was now seeking leave to amend the application for a patent for an invention communicated to him from abroad by the Marquis Luigi Solari, of Italy, has brought about considerable discussion and was made capital of by those who do not believe in the integrity of the inventions of Mr. Marconi. It seems, however, that the invention involved in the Solari application is only a part of the whole system and it is no doubt the result of the amicable relation between the Marquis Solari and Mr. Marconi.

Production of Zinc.

The maximum production in the history of the zinc industry in the United States was reached in 1901 with an output of 140,822 short tons, as compared with 123,886 tons in 1900, and with 129,051 tons in 1899. The largest gain production was made by Kansas, with an output of 74,240 short tons, as compared with 62,136 tons in 1900; Illinois also made a considerable gain from 38,750 short tons in 1900 to 44,896 in 1901.

The average realized price for zinc in 1901 was $24.21 per short ton, as compared with $26.50 in 1900, with $38.50 in 1899, with $28.44 in 1898, and with $22.28 in 1897.

A number of changes were made in the way of increase of capacity in plants already in existence, and several new plants were completed or were in process of construction during the year.

During 1901 the home consumption of spelter was very large, being estimated by Mr. Kirchhoff, United States Geological Survey, at 141,697 short tons, as compared with 99,400 short tons in 1900, and with 124,585 short tons in 1899. These figures show an exceptionally heavy consumption of spelter, which is reflected in the decline of exports of zinc in 1901 to 6,780,221 pounds, valued at $288,906, as compared with 44,802,577 pounds, valued at $2,217,693, in 1900, and with 13,509,316 pounds, valued at $742,521 in 1899. As heretofore, the exports went chiefly to the United Kingdom, the quantity being 5,167,274 pounds for 1901, as compared with 33,378,240 in 1900.

The year 1901 was one of fair prosperity for the zinc mining industry of southwest Missouri and southeast Kansas, which district maintains its position of overshadowing importance. The production of zinc ore in the Gelena-Joplin district in 1901 was 256,920 short tons, valued at $6,318,249, as compared with 244,629 short tons, valued at $6,583,944, in 1900—an increase for 1901 in quantity of 12,291 short tons, but a decrease in value of $265,695.

The imports of zinc in 1901 amounted to $76,059, as compared with $128,090 in 1900, and with $165,667 in 1899.

The world's production of zinc in 1901 is estimated at 501,494 long tons, as compared with 470,937 long tons in 1900, and with 481,854 long tons in 1899. The United States furnished in 1901 25.1 per cent of the world's production, 23.5 per cent in 1900 and 23.9 per cent in 1899. The largest producer in the world is the Vieille Montague Company, which has the record of 72,330 long tons in 1901, as compared with 68,815 in 1900. The Lanyon Zinc Company, of Kansas, would take rank as the second largest producing company in the world, the next three largest makers being in Silesia.

New Automatic Telephone Company.

The Westerly Automatic Telephone Company, of Westerly, R. I., has been formed under a special act of the legislature, and has organized with the following board of directors, composed of prominent local professional and business men: John Champlin, M. D.; Albert B. Crafts, George C. Bartrum, William S. Slocum, Robert A. Sherman, George L. Stillman, Thomas J. Bannon and James A. Welch.

The company has adopted the Strowger automatic telephone exchange system, and has ordered 100 telephones and switchboards with an ultimate capacity of 1,000 telephones.

The first carload of material has arrived, and the work of installing the plant is now actively under way.

Joseph B. Baker, of Boston, for many years connected with the experimental department of the American Bell Telephone Company, is consulting engineer, and Mr. O. S. Bowen, formerly with the New Bedford and Fall River Automatic Telephone companies, is superintendent of construction. It is hoped to open the exchange for service by September 1, and it is proposed to extend the service to Watch Hill, Stonington, Noyses Beach and other surrounding towns in the spring.

The imports of mica in 1901 were valued at $335,054, as compared with $319,560 in 1900, and with $275,984 in 1899.

Memorial Service.

A memorial service for the late Mr. John W. Mackay, president of the Postal Telegraph Cable Company, was held at St. Leo's Church, 11 East Twenty-eighth street, New York, on Tuesday morning, July 29. The Rev. Thomas J. Ducey officiated. Among the persons attending the service were A. B. Chandler, W. H. Baker, E. C. Bradley, C. P. Bruch, of the Postal Company; Vice-President Thomas F. Clark, of the Western Union Telegraph Company, and Mrs. Collis P. Huntington.

Although but a few hours' notice was given the church was crowded by personal and business friends who gathered out of respect for the memory of this distinguished telegraph-cable builder and financier.

Mica.

Mica has been found in many states, says Dr. Joseph Hyde Pratt, United States Geological Survey, but in only a few has the occurrence been of commercial value. In the last few years mica has been mined in the following states: Alabama, Arizona, California, Colorado, Connecticut, Idaho, Maine, Missouri, Nevada, New Hampshire, New Mexico, New York, North Carolina, Rhode Island, South Dakota, Virginia and Wyoming. During 1901, however, the only states that produced any mica were New Hampshire, New Mexico, North Carolina and South Dakota, by far the larger amount being obtained from North Carolina.

The total amount of plate mica produced in the United States during 1901, as reported to the Survey, was 360,060 pounds, valued at $98,859, as compared with 456,283 pounds, valued at $92,758, in 1900. There was a large falling off in the amount of scrap mica produced in 1901, estimated at 2,165 short tons, valued at $19,719, as compared with 5,497 tons, valued at $55,502, in 1900. The importation of mica from Canada and India tends to curtail the production in the United States, especially the India mica, which can be imported at a cost lower than that for which it can be mined in this country. There was an increase in the production of plate mica in North Carolina, but a large falling off in the production of scrap mica.

The use of mica in sheets for stoves, chimneys, etc., has increased greatly, but still more the use of small circular discs and rectangular pieces of mica for insulation purposes and for electrical apparatus. Ground scrap mica is used in the manufacture of wall papers, lubricants, etc. Scrap mica, also, arranged on a wire net coil, and then pressed into proper shape, is used very satisfactorily as a boiler tube covering, mica being a nonconductor of heat.

Reviews of Current Engineering and Scientific Literature.

Giving Concisely the Substance of Important Papers in the Scientific, Electrical and Engineering Press of the World.

The Normal Saturation of Alternator Fields.

The term "saturation" is used more or less indefinitely in dynamo design. Mr. R. Beattie in this article attempts a strict definition of the term. The term "regulation efficiency" here is taken as the ratio between the voltage adjustability and the percentage of the voltage drop. In general, the regulation efficiency will be low at low degrees of saturation as well as at high. This readily suggests the adoption of that degree of saturation which makes the regulation efficiency a maximum, as a useful working definition of normal saturation. In most instances the normal saturation as thus defined will be the best at which the machine can be worked. It will be understood that the regulation efficiency as above defined does not form a strict basis for a comparison between the regulating qualities of different machines.—*Electrician* (London), July 11.

New Equipment of the Liverpool Overhead Railway.

A notable advance has recently been effected in the Liverpool overhead railway by means of a new type of equipment supplied by Messrs. Dick, Kerr & Company, Limited. The total length of this line is a little over six and a half miles, the trains being made up of two or three carriages, the larger trains weighing about fifty-five tons. With the old equipment the entire distance was run in thirty-two minutes, including sixteen stops, or practically at a schedule speed of twelve and a half miles per hour. Twelve months ago it was decided to experiment with a new equipment in order to ascertain what acceleration could be obtained. A guarantee was entered into by the above firm to run the whole distance, including sixteen stops, in twenty and nine-tenths minutes; in other words, to increase the schedule speed from twelve and a half to nineteen miles per hour. A careful series of tests and trial runs was made and it was demonstrated that the new train would make the journey easily in twenty and a half minutes. From the curves it will be seen that the acceleration reached was four and two-tenths feet per second per second, or nearly three miles per hour per second, the average acceleration being over one mile per hour per second. Each of the new trains is to be fitted with four 100-horse-power railway motors designed by S. H. Short and built at the works of the English Electric Manufacturing Company. The efficiency is unusually high, being practically ninety-three per cent at the full load of seventy-five kilowatts. The weight is 4,200 pounds, being but forty-two pounds per horse-power. The twelve trains of the new type will replace fourteen of the old and accommodate the same number of passengers.—*Electrical Review* (London), July 4.

Protection of Electrical Machines.

This paper, by Mr. J. B. Clarke, discusses the proper use of fuses and circuit-breakers in three-wire systems. Usually the application of the fuse involves no consideration beyond the primary one of efficient protection and ease of manipulation; but in the case of the three-wire balanced system, the question as to how far protection is advisable is one that requires examination. That every circuit should be protected is not a safe rule to go by, for when the method of balancing is by means of a motor-dynamo, this rule does not apply. The reasons for this are as follows: The essential function of the balancer is to maintain a difference of potential in the neutral wire which bears the same relation to the positive as to the negative wire of the circuit, and it is essential that there should be no interruption in the working of the balancer while it is across the mains for the purpose of balancing. It must be remembered that in every case, but when the load on one circuit equals the load on the other, the balancer is a necessary adjunct to the proper distribution of potential of the two circuits. It is evident that should the balancer be cut out of the circuit during the "out-of-balance" load, the effect would cause dissatisfaction to the consumers. Experience shows that the balancer should not be subject to automatic devices, but when put across the mains should not be detachable except by the attendant, who would switch in other means of balancing. In the case of a slight fault on one side of the system, it is the duty of the balancer to burn it out or cause the fuse in the faulty section to blow. In the event of a severe fault the sudden short-circuit on one side would momentarily increase the voltage on the other. Here one of the feeder fuses should give way before the armatures of the balancer were under strain long enough to seriously harm them by overheating. During the operation of starting a balancer, cutouts or fuses are required in circuit, but these should not be left in circuit after the machine is started. The conclusion is drawn that the balancer is a necessary machine, and on no account to be cut out of the circuit while the generators are supplying current to the outers. If the balancer fails to perform its operations, it is time to shut down the generating station. Consequently, no risk should be incurred by inserting fuse or cutouts in circuits, but reliance should be placed on a good, high-grade machine. —*Electrical Review* (London), July 11.

Arctic Magnetic Observations.

Last year a systematic series of observations on terrestrial magnetism, atmospheric electricity and aurora was commenced by Professor Birkeland and his associates. The first report of that work has been published. Observations were made at Bossekop in the north of Norway. For magnetic observations self-recording photographic apparatus was employed. Fast runs were made simultaneously on certain prearranged days at Bossekop and Potsdam. The comparison of the results showed simultaneous or practically simultaneous occurrence on several occasions of small regular magnetic waves at the two stations. The comparatively great distance of some 2,000 kilometres between the two stations makes the result of special interest. A considerable part of the report is occupied with a description of experiments with electric discharges in vacuum tubes in which Professor Birkeland has succeeded in producing a phenomenon having a close resemblance to some of the more prominent features of the aurora. There is also a description of

the bearing of the observations and experiments on Professor Birkeland's theory of the cause of the aurora and magnetic storms. This work is to be regarded only as introductory to a larger scheme in which he is about to embark and in which he desires the cooperation of the magnetic and meteorological observatories. The Norwegian Government is to maintain four stations in operation from August, 1902, to June, 1903. They are to be situated at Bossekop, in Iceland, Spitzbergen and Nova Zembla. At each of these stations there will be obtained photographic registration of the horizontal and vertical components of magnetic force and of the declinations. Rapid runs are to be made on certain specified days and times. Professor Birkeland is anxious that as many magnetic observatories as possible should participate in this scheme of rapid registration. He also asks the cooperation of the meteorologists in observing cirrus clouds, and especially in recording the direction of cirrus bands when such exist. For this work no special magnetograph is needed. When Eschenhagen described his early observations he apparently believed that earth magnetic waves were restricted to definite short periods, notably one of about thirty seconds. The records at Potsdam and Bossekop, however, show waves of all periods from eight or ten seconds up to several minutes.—*Nature* (London), July 3.

Commercial Education in Japan.

The advances which the Japanese have made, not only in technical but also in general education, have frequently been indicated. They have been wise enough to recognize that real progress is impossible without a solid basis of general culture. Moreover, they do not interpret technical education in the narrow sense in which it is so often interpreted, but under it include all that is necessary for carrying on the industrial and commercial business of the nation. It is not generally known that during the last quarter of a century Japan has paid much attention to the commercial side of education. At present there are twenty-seven commercial public schools in Japan. These may be classified in three divisions, according to their standard of education: First, the higher commercial college; second, ordinary commercial schools; third, elementary commercial schools. The higher commercial college of Tokyo was organized by the department of education in 1885. In addition to the Japanese professors, several foreign instructors in commercial subjects and languages have been called in. The work of the college is supplemented by sending a number of the best students to foreign countries for the study of special departments. The course of instruction extends over one year in the preparatory course, three years in the principal course, and two years in the professional department or the post-graduate course, making a total of six years. Especial attention is paid to commercial morality and gymnastics. The principal course of study, extending over three years, includes all the more theoretical subjects necessary in a commercial course. A course in mechanical engineering is given. The professional course of the higher commercial school is intended for such graduates of the upper course of the college as are desirous of pursuing their studies further through one particular branch, or to engage in the consular service. This course includes, among other subjects, commercial and marine law, public international law, consular service practice, foreign and domestic commercial usages, banking, railways, shipping and insurance. The courses of study in this department have proved themselves to be very useful, especially for those who apply for consular examination. All that has been done in Japan has been introduced from the most advanced countries of Europe and America, and their arrangements are yet far from perfect. However, it must be admitted that our merchants and manufacturers would find in the curriculum and method of the high commercial college in Tokyo much that is worthy of their most careful attention.—*Engineering* (London), July 4.

Armature Reaction and Fall of Potential on Dynamo-Electric Machines.

Predetermination of the operation of the machine before construction is a question of first importance. Dimensions are always increasing, making tests at the shop more and more difficult, sometimes impossible. For some time attempts have been made in this direction. The first of these, by M. Behn-Eschenburg, attempts the solution by a study of the short-circuit characteristic, in this way determining the self-induction of the machine, and, by means of graphic diagrams, the fall of potential. The next attempt, by M. Rothert, consists in determining, by means of the characteristics of the machine and the short-circuit characteristic, the excitation required to give the terminal voltage and to drive the current through the armature. Combining these values vectorially gives the total exciting current. The first method gives too large a drop, the second too small. Blondel considers separately the power and wattless reactions, applying to each a separate determination. Potier, by a similar method, combines those of Rothert and Behn-Eschenburg. Unfortunately, none of these methods gives satisfactory results. Those given by the following method are thought by Picou to be more reliable. The armature reaction is studied directly and the effect of this in increasing the leakage flux is determined. The construction is as follows: Having the static characteristic, lay off below the X-axis a line making an angle with the latter, the tangent of which is equal to the permeance of the leakage path of the circuit. Now, if from any point on the characteristic a vertical line be dropped until it cuts this permeance characteristic, and from this point a line be drawn horizontally to the left, the demagnetizing ampere-turns of the armature may be laid off on this. Joining the point on the static characteristic with the point thus determined by a straight line, where this latter cuts the X-axis, gives the demagnetizing effect exerted in the air-gap. The actual construction, however, is not as simple as this, since the permeance characteristic is not a straight line and it is with difficulty determined. Having this, however, the construction is as above. From the point where the line drawn from the static characteristic to the end of the line representing the armature ampere-turns cuts the X-axis, erect a perpendicular to cut the static characteristic. From this point draw a line parallel to the permeance characteristic, and where this cuts the vertical from the first point on the static characteristic, will give the terminal voltage of the machine. In this way a dynamic characteristic may be constructed which is practically parallel with the static. The cross-magnetizing effect is next considered and an actual weakening of the field due to this reaction is demonstrated. The effect of slotting the pole-piece is considered, showing the advantage of this construction. The above analysis is applicable to continuous-current machines as well as alternating. For alternators we must consider in addition the effect of self-induction in the armature. Amortisseurs are shown to have a diminishing effect on the reaction. This analysis is applied to two machines with fairly satisfactory results; but, since it is necessary to know beforehand certain constants of the machine, and particularly the quality of the iron, the method can not always be applied satisfactorily.—*Bulletin of the Société Internationale des Électricians* (Paris), June.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A Direct-Connected Generator.

In large cities, while the central station still supplies a very large proportion of the current demanded for lighting and power purposes, it being called upon for an increasing supply from time to time, the installation of isolated units is increasing as the cities grow; and, with the erection of the modern sky-scraper, it almost invariably follows that a self-contained unit is located in the building to supply its own power and lighting current.

The direct-coupled type of direct-current generator is in general use to supply power and lighting circuits, and the accompanying illustrations show a type of machine which has been designed for direct connection, which the manufacturer claims has proven very satisfactory. Referring to the illustrations, Fig. 1 shows a ten-pole, 400-kilowatt, direct-coupled generator. This machine is built with a vertical split frame and runs at 120 revolutions per minute.

The magnet frame is cast from carefully selected soft gray iron of high permeability. It is divided either horizontally or vertically, according to careful consideration of the points of relative value and convenience of access to the armature. In the smaller sizes, the frame is split horizontally and the upper section is removed by means of a crane or block and tackle. Fig. 2 shows a ten-pole, 300-kilowatt, 150 revolutions per minute, horizontal split-frame machine, with armature removed. Fig. 3 is a six-pole, 50-kilowatt, 275 revolutions per minute, horizontal split-frame generator. Fig. 4 shows one of the laminated pole-pieces. The larger machines are provided with bases that allow the two heavy vertical sections of the field frame to be separated horizontally at right angles to the shaft. The pole-pieces are made of wrought-iron punchings assembled and riveted together before casting them into the field yoke. The peculiar design of the outer end of the pole-pieces, and the method of casting them into the frame, ensure a permanent and perfect magnetic circuit of low reluctance, this being claimed to be one of the elements of great advantage in this generator. On the inner ends of the pole-pieces are bolted pole-shoes of such shape as to properly distribute the magnetic flux in the air-gap to aid in securing sparkless commutation with wide and rapid fluctuation in load. The pole-shoes also serve to hold the field coils in place.

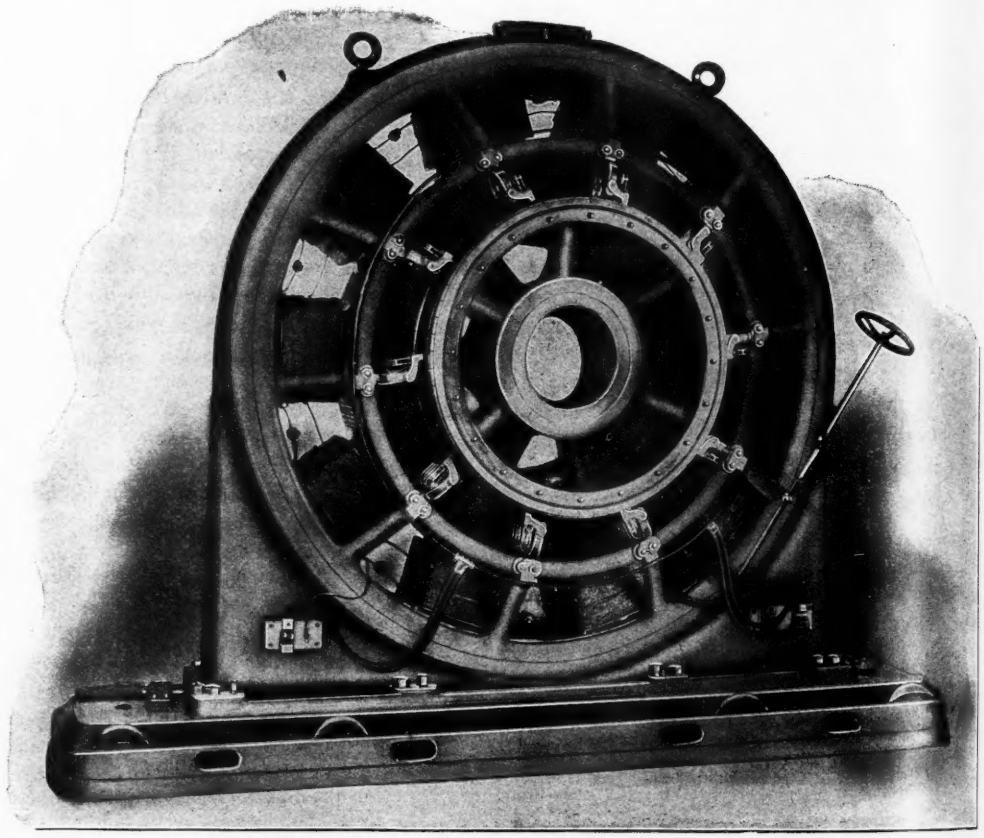


FIG. 1.—TEN-POLE, 400-KILOWATT DIRECT-COUPLED GENERATOR, VERTICAL SPLIT FRAME.

The armature is ventilated in a thorough manner, so that there is a free circulation of air around the laminations of the core and the windings, thus ensuring a low temperature when in operation. The core is constructed from punchings of thin, soft steel specially annealed and japanned before assembling, so that heating, due to eddy currents and hysteresis, is exceptionally low. The armature coils are made of pure copper of high conductivity, properly shaped on forms, and are all interchangeable. Each conductor is carefully insulated and contains no joints except at the connection with the commutator lead. These coils are securely embedded in uniform slots in the core circuits and are supported on the ends by cast-iron flanges, ensuring freedom from mechanical injury. Fig. 5 shows the engine end of the armature of a ten-pole, 400-kilowatt machine.

In all multiple-wound armatures, points of equal potential are connected by means of equalizer rivets mounted on an insulated stud inside the commutator end of the conductor drum. The alternating currents which flow through the equalizer rings compensate for any inequality which may exist in the strength of different poles and permit the machine to operate successfully even though the armature should be mounted eccentric to the field-frame circuit.

The commutator is mounted on an extension of the armature spider hub to which it is keyed. This construction has been selected for its even wear and high insulating qualities. Even wear of the bars is essential to the long life of the

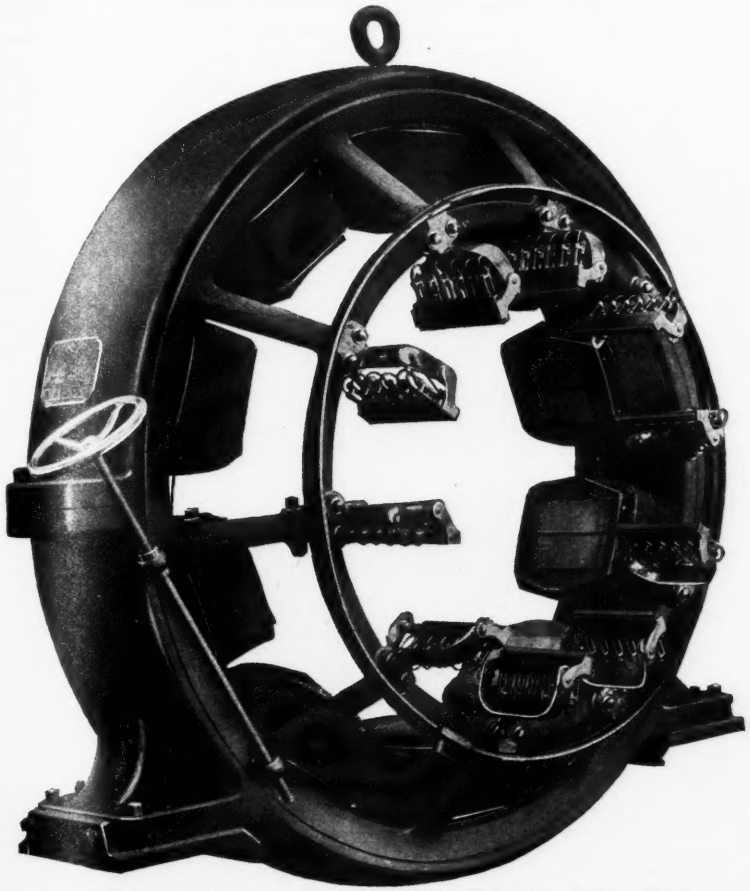


FIG. 2.—TEN-POLE, 300-KILOWATT GENERATOR, HORIZONTAL SPLIT FRAME

renders the commutator independent of the shaft and undisturbed by its removal. The bars are made of hard-drawn copper, carefully fastened and thoroughly insu-

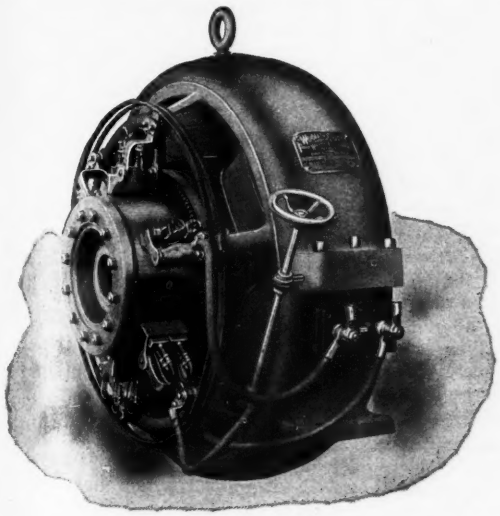


FIG. 3.—SIX-POLE, 50-KILOWATT GENERATOR.

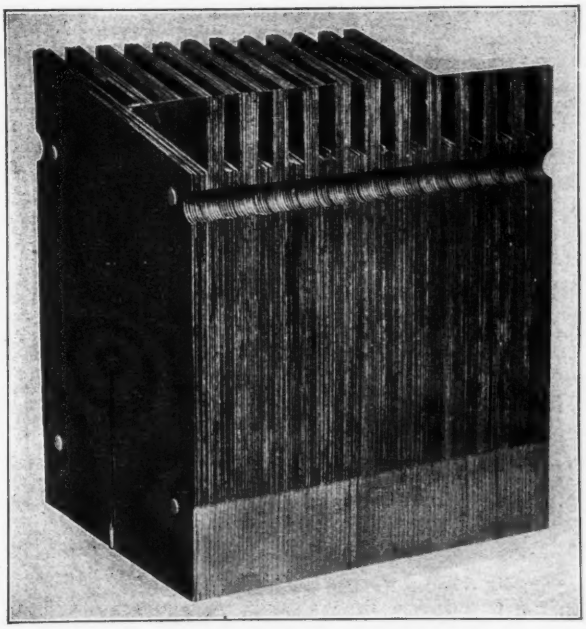


FIG. 4.—THE LAMINATED POLE-PIECE.

lated from each other by a soft grade of mica. The mica sections are as thin as is consistent with good insulation. Material commutator and brushes, and the heating, due to friction, high-resistance contact, and sparking of brushes, is reduced to a minimum, and there is but little temperature rise in the commutator. The commutator bars are held rigidly in position on the commutator drum by sectional clamping rings, each section of which is held firmly against the top of the upper end surface of the bars by radial bolts by means of which a direct pull is exerted in opposition to the centrifugal strain. This method of construction secures the locking of the clamps on the commutator and firmly seats each bar on the mica insulating ring on the commutator drum, thus ensuring against high bars or an eccentric commutator.

The brush-holder and brush-holder arm are of unique design and have several points of simplicity and strength desirable in machines of this type. Fig. 6 shows the brush-holder complete. The carbon brushes are held in a radial position in one long, narrow, brass box, and are so arranged that the pressure of any brush on the commutator can be adjusted without in any way disturbing the other brushes or changing their adjustment. Flexible copper leads from box to brush prevent injurious heating of the adjustment spring by its use as a conductor. One end of the lead is soldered to a large brass plate screwed to the brush, and the other end is attached to a binding-screw on the brush-holder box, thus securing positive connection between brush and box. The brush-box is mounted between the ends of a wish-bone-shaped brass casting and is held rigidly in position by a dove-tailed joint and locking stud on each end. Rotation in

either direction may be provided for by simply removing two cap screws, reversing the brush-box without removing the brushes, and setting the brush-holder yoke

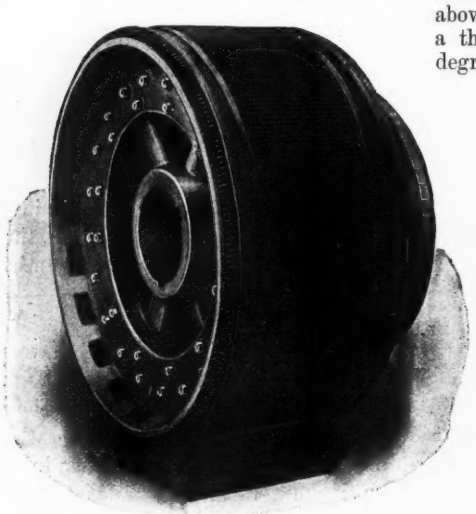


FIG. 5.—ARMATURE OF TEN-POLE, 400-KILOWATT GENERATOR.

at the proper commutation point. The arm carrying the brush-box is bolted to the circular yoke which is supported in a groove in the field yoke. The brush-

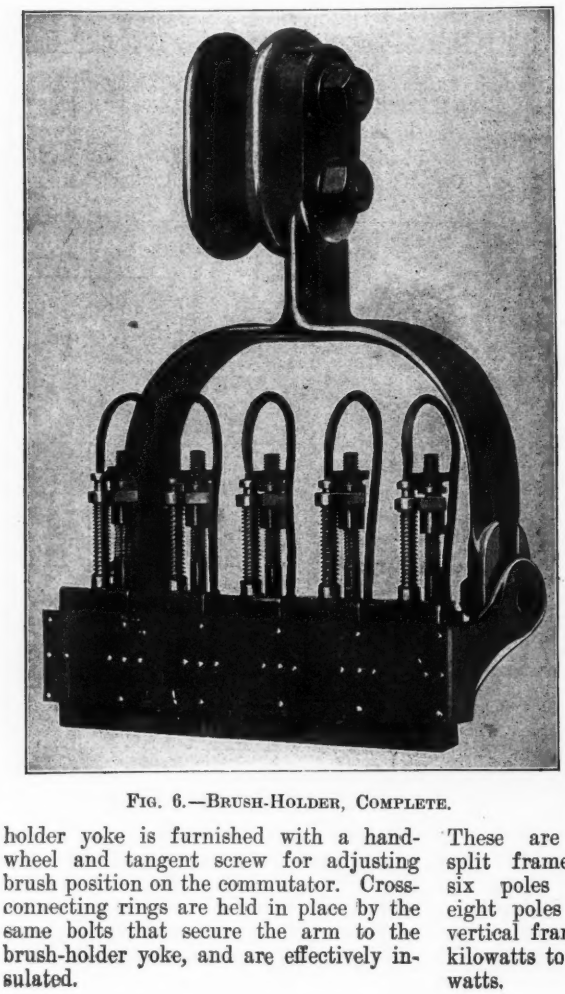


FIG. 6.—BRUSH-HOLDER, COMPLETE.

holder yoke is furnished with a hand-wheel and tangent screw for adjusting brush position on the commutator. Cross-connecting rings are held in place by the same bolts that secure the arm to the brush-holder yoke, and are effectively insulated.

The manufacturer states that each generator will carry its rated current at rated voltage and speed under normal conditions of ventilation for twenty-four hours continuously, with a rise in temperature above the surrounding air, as measured by a thermometer, not exceeding thirty-five degrees centigrade on the armature and field coils and forty degrees centigrade on the commutator. With the current then increased fifty per cent at rated voltage, making fifty per cent overload, the generator will operate for two hours with an increase of temperature not exceeding fifty-five degrees centigrade in any part of the machine. Each generator will carry an overload in current of fifty per cent in rated voltage without movement of the brushes, and an overload in current of 100 per cent momentarily without injury. The Fort Wayne Electric Works, Fort Wayne, Ind., manufacturer of the "Wood" systems, manufactures this type "MPL" direct-coupled generators. These are made with a horizontal split frame in classes ranging from six poles and twenty kilowatts to eight poles and 200 kilowatts; in the vertical frame, from eight poles and 200 kilowatts to fourteen poles and 800 kilowatts.

Switches.

Probably in no one device which has been designed to operate as an auxiliary in electric service does the form and requirements of service differ so widely as in switches of every description. The improvements which have been made from time to time have hardly kept pace with the increasing demand for special apparatus which would embody some particular feature to make it successful for a peculiar line of work. Almost every new installation finds it necessary to design a switch which is different in the nature of the work which it must perform from those commonly used in prior operations. The accompanying illustrations show a few types of switches which have been recently placed upon the market and represent the latest ideas which have been worked out in this direction of the manufacture of electrical apparatus.

FIG. 1.—OPERATING HANDLE OF OIL SWITCH WITH CIRCUIT-BREAKER ATTACHMENT.

In Fig. 1 is shown a front of the board view of the operating handle of an oil switch with circuit-breaker attachment. This differs materially from any other style of switch which has yet been offered. Its special features are claimed to be in simplicity of construction, special long break between terminals and blades, high insulation of working parts from front of the board, the design permitting installation to suit a great variety of con-

ditions, and zinc-tipped blades for high currents. There is a separate tank for each pole, and the tank is self-contained and removable, affording free access to working parts even while the switch is carrying current. While the claim is often made that the long break between terminals and blade is not necessary when the break is made in oil, the endeavor in this system is to anticipate every possible contingency and to provide always an ample factor of safety. Freedom from provoking delays and serious accidents justifies the extra outlay which, as a matter of fact, is very small. Again, although the break is made in oil, zinc tips are provided on the high-voltage switches, as experience has demonstrated that the more or less pitting on the blades is inevitable, this in time making bad contacts. It is claimed that the zinc tips minimize this, and, even under the worst conditions, are easily removed and replaced by new ones. Immersing each pole in a separate porcelain-lined compartment precludes leakage from pole to pole through the oil and is a precaution for short-circuit inside the switch. Provision is made for drawing off and filling without removing the tanks from place. By taking out the four screws, which pass through the marble cover and without having to draw off the oil, the tank may be removed without in any way disturbing the switch while it is carrying current.

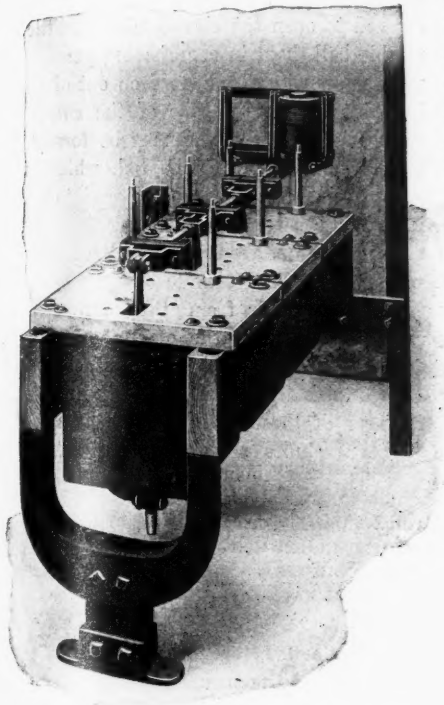


FIG. 2.—BACK OF THE BOARD—VIEW OF THE SWITCH IN DETAIL.

Fig. 2 shows the back of the board view of the switch in detail.

Fig. 3 shows a double-pole, single-throw slide switch with circuit-breaker attachment. This combination slide switch and circuit-breaker possesses the same general characteristics and appearance as a slide switch and is virtually the latter with a circuit-breaker attachment added. The essential difference, however, is that when used as a switch it is only a switch, the circuit-breaker is not in action and the operator does not have to overcome a spring in closing. When closed, any overload instantly operates the circuit-breaker attachment, opening the circuit. If thrown in on an overload, the combination will not remain closed, as the springs are strong enough to throw it open without the usual hammer blow. All contacts are provided with enclosing boxes, which have a simple attachment whereby an insulating shutter or arc-rupturing device is intervened between the contacts immediately after their separating. Up to 3,000 volts each single pole of the combination switch and circuit-breaker will break the circuit at two points, each of these points being provided with the enclosing box, arc-rupturing device; thus a two-pole, 3,000-volt, switch circuit-breaker has four breaks; a three-pole, six breaks.

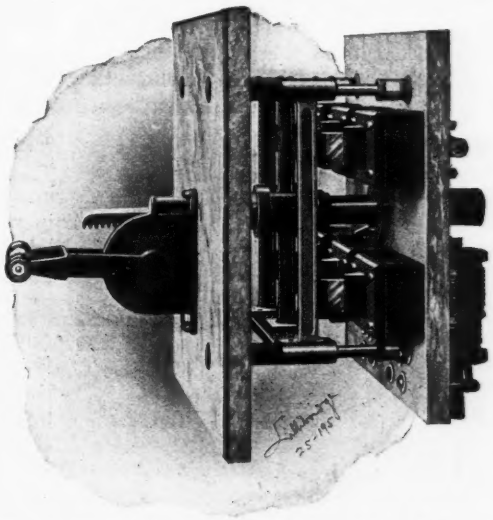


FIG. 3.—DOUBLE-POLE, SINGLE-THROW SLIDE SWITCH.

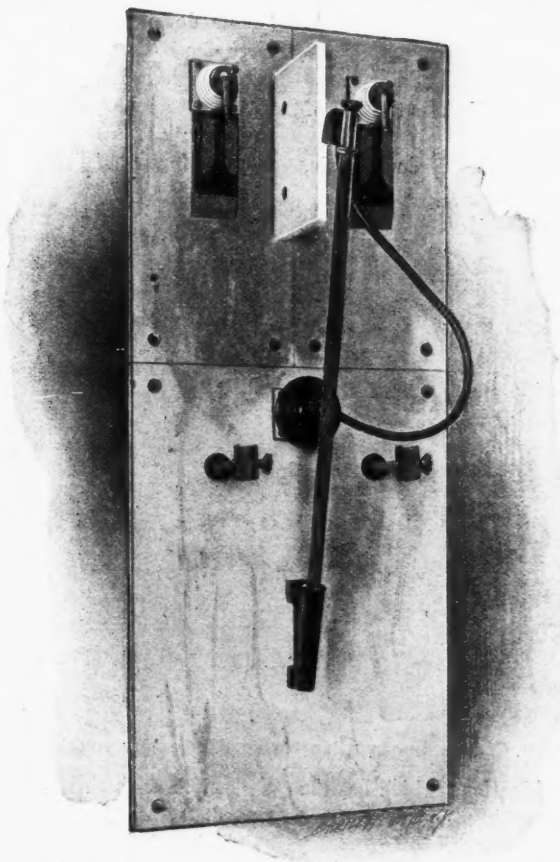


FIG. 4.—DOUBLE-THROW PLUG SWITCH FOR 30,000 VOLTS.

For pressures exceeding this and up to 6,600 volts, four such breaks are provided

on each single pole. The advantages of such a combination of switch and circuit-breaker for crowded switchboards are evident. Occupying the space of a single piece of apparatus this combination performs the functions of two, simplifies the

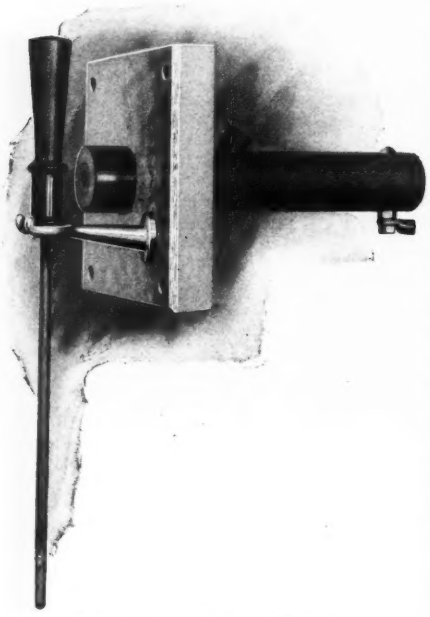


FIG. 5.—STAB-SWITCH, OPEN.

operator's movements and saves the cost of duplication of many parts.

These are also made in double-pole, double-throw combinations, which has the advantage of occupying no more space than a single-throw switch.

In Fig. 4 is shown a double-throw plug switch for voltages up to 30,000. This switch consists of a long wooden handle well insulated, on the upper end of which is a contact piece made to fit over the tapering terminal mounted near the top of the board and out of reach of the attendant. The contact piece is connected to a flexible cable, the other end of which connects with the lower terminal. The lower terminal proper is inserted well into the marble to provide against accidental contact. The connection between cable and lower terminal is through the medium of a movable receptacle surrounded by a hard rubber handle and further protected by a rubber handle guard. A locking device prevents the circuit being broken at this point. The contact piece at the top of the wooden handle has cast with it a projection of a form to slide between the hard rubber guide placed on the switchboard just below the upper terminal. A straight-line motion is thus assured and danger of breaking or bending the terminal removed. The plug connections are tapering and ground to form good contact surfaces. The tips of the contact piece and the tapering terminal are of zinc and detachable. The board may be cleared by unlocking the movable receptacle, as the flexible cable and wood handle are attached thereto.

The circuit is opened by pulling the handle down, thus releasing the contact piece from the tapering plug and then swinging it back over the shoulder, moving away from the board until the arc is ruptured. An arc of considerable length may be formed. This does not damage the switch as the breaking points are zinc tipped.

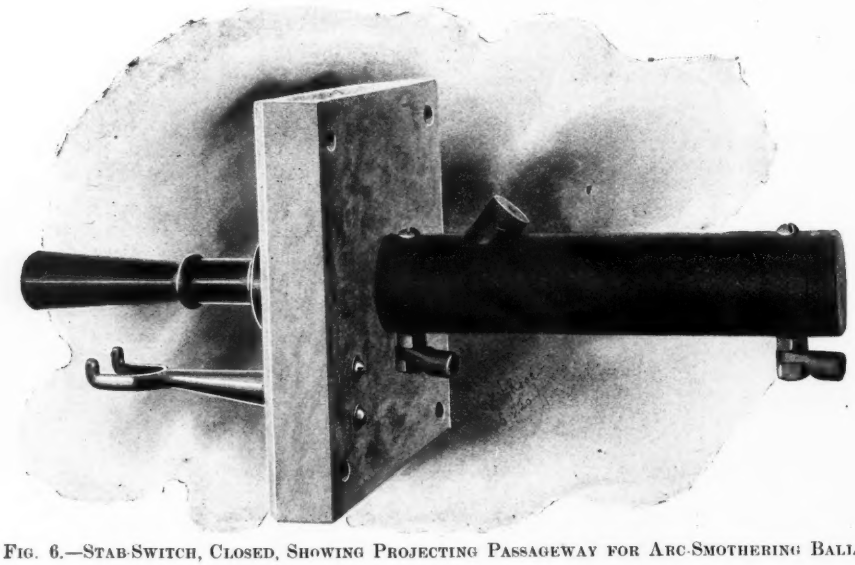


FIG. 6.—STAB-SWITCH, CLOSED, SHOWING PROJECTING PASSAGEWAY FOR ARC-SMOTHERING BALL.

The terminals are mounted on a marble switchboard and are thoroughly insulated from it by means of rubber bushings and porcelains designed so as to give a large creeping space between the terminal and board, thus obviating the danger of leakage. A pocket is provided to receive the lower end of the long handle when the switch is not in circuit. To hold the switch in place when in circuit, a supporting bracket with a set screw is provided near the bottom. This switch is made for single and double throw.

Fig. 5 is a little device of great efficiency, designed particularly for series arc and series incandescent circuits. This is the "SKC" stab switch. Fig. 5 shows the appearance of the switch when open. The switch is made of a thick fibre tube which is held to the switchboard marble by an overlapping flange escutcheon. The escutcheon is of hard rubber and very neat in appearance. The circuit is closed by inserting a rod connecting the front terminal and rear terminal, the front terminal being situated immediately behind the board and the rear terminal at the end of the thick fibre tube. Withdrawing the rod to open the circuit allows a little marble ball, held in a projecting passageway, as seen in Fig. 6, to drop out of its tube into the main tube of the switch, smothering any arc that may be formed. In closing the circuit the rod, which is pointed, pushes the marble ball up into the tube. This switch operates satisfactorily up to ten amperes at 7,000 volts, and is very compact and easy to operate. It is readily removed from the marble by simply unscrewing the escutcheon.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., is the manufacturer of these switches. The "SKC" system includes switches to meet every possible requirement from the simplest small knife-switch to the great 60,000-volt combined switch and fuse or the high-capacity oil-switch and circuit-breaker. This company claims to make provision for all varieties of service.

A Modern Telephone System for Vincennes, Ind.

The Kellogg Switchboard and Supply Company, Chicago, Ill., has recently closed a contract with the Northern Construction Company, of Bryan, Ohio, for a common battery multiple switchboard for Vincennes, Ind., having 1,500 lines ultimate capacity, and a framework large enough for 3,000 lines. The present equipment will contain 640 lines. The switchboard will consist of two 6-panel, 3-position sections. The exposed cabinet-work, including the cable-turning section and movable end-panels, will be of selected mahogany of a dead finish. Included in this contract is 600 standard common battery wall telephones, quarter-sawed oak woodwork, and concealed line binding-posts; also all necessary power apparatus, main and intermediate distributing frames, relay racks and sneak-current arrester equipment.

CURRENT ELECTRICAL NEWS

COMMERCIAL NEWS

DOMESTIC AND EXPORT

MORTGAGE FOR $5,000,000—A mortgage for $5,000,000 has been filed for record in the County Clerk's office at Portland, Ore., by the Oregon Water Power and Railway Company, in favor of the Land Title and Trust Company, of Philadelphia, as trustee. The loan is for the purpose of paying for property about to be acquired by the Oregon Water Power and Railway Company and for various other uses. The mortgage runs for thirty years, or at the option of the borrower the bonds may be liquidated in ten years.

LIGHTING COMPANY TO ENLARGE ITS PLANT—The Queens Borough Gas and Electric Company, Long Island, which has recently bought out the Queens Borough Light, Heat and Power Company, of Rockaway Beach, and the town of Hempstead Gas and Electric Light Company, of Far Rockaway, has given a mortgage of $2,000,000 on its property in both places to the Guaranty Trust Company, of New York, as trustee. The mortgage is given to secure the payment of an issue of two fifty-year five per cent gold bonds, the proceeds of the sale of which are to be used for the liquidation of the mortgage for $250,000 on the Far Rockaway plant; $400,000 of the proceeds of the bonds are to be used in the acquiring of further property rights, privileges or franchises in the extension of the works. The electric lighting plant of the new company is said to be a very fine one and large additions are contemplated, all of which will be provided for from the sale from time to time of the two million dollar issue of the bonds.

THE BROOKLYN TUNNEL—The Rapid Transit Commission of New York city, after an extended public hearing, awarded the contract for a tunnel under the East River between the boroughs of Brooklyn and Manhattan, by means of which the subway rapid transit system is to be extended, to the Belmont-McDonald syndicate, the figures of which provide that the tunnel shall be built for $2,000,000 and the terminals for $1,000,000 additional. The commission also adopted resolutions ordering plans for a second tunnel and for extensions and terminals that will reach the main centres in Manhattan and Brooklyn, establishing the best possible interborough connection. The Brooklyn Rapid Transit Company offered a bid of $7,000,000 for the extension to Brooklyn, with $1,000,000 for terminals, and with this bid was the assertion that the Brooklyn corporation would lose $1,000,000 by getting the contract, as the actual cost of the tunnel would be $8,000,000, the company, however, expecting to more than make up the additional loss from increased traffic.

POWER PLANT ON THE MCCLOUD RIVER—A plant for the generation of electricity for power and light is being installed on the McCloud River, Redding, Cal., by the McCloud River Electrical Power Company, with headquarters in that city. The scheme comprises the installation of a plant with a capacity to generate electricity for sufficient horse-power, not only to supply the means for power in the streets of Shasta County, but it is said the pole line will be extended eventually as far as Sacramento. Work on the big plant has already been commenced and a wagon road has been built from the Southern Pacific Road at Bairdsboro, a distance of twelve miles, to the power-house on the McCloud River. Contracts are now being let for the erection of a large dam across the river and a twelve-mile canal to the power-house. It is understood that over $300,000 worth of machinery is already in Redding awaiting the erection of buildings for its proper installation. The company has the choicest water rights on the McCloud River. Mr. A. F. Johns, at present in San Francisco, is the director and general manager. The plant will cost $800,000, and is expected to be in operation February 1.

ELECTRIC RAILWAYS

SODUS, N. Y.—The Rochester & Sodus Bay Railway has passed into the control of the Rochester Railway Company.

NORWALK, OHIO—A new electric road is being projected from Fremont to Sandusky City, to pass through Riley and Townsend townships.

AKRON, OHIO—The Cleveland, Richland & Akron Transit Company has purchased a site for its power-house in this city. The officers of the company announce that work on the plant will be started at once, and that the line will be in operation before next winter.

CAMDEN, N. J.—The People's Traction Company, chartered to build and maintain street railways within the state, has been incorporated. It is capitalized at $175,000, and among its incorporators is T. R. Sweigart, former general superintendent of the Philadelphia & Reading Railway Company.

SPRINGFIELD, MASS.—The Springfield Street Railway Company has plans nearly perfected for practically doubling the capacity of the power plant supplying its entire system with electricity, and it is now proposed to break ground for the additions to the station at once. The improvements will cost in the neighborhood of $250,000.

MORRISVILLE, N. J.—The Philadelphia, Bristol & Trenton Street Railway has been granted an ordinance to build a trolley road. The ordinance requires a promise of a five-cent fare to the centre of Trenton and an agreement to run cars every half hour. The company must take out a permit within three months and begin the work of construction thirty days later.

JACKSONVILLE, FLA.—The Jacksonville street railway properties have passed into control of the new owners who recently consummated a deal with the Plant Investment Company. The trolley lines are now the property of Stone & Webster Company, of Boston. It is stated that the new company intends to expend $150,000 within the next twelve months on improving the Jacksonville lines and terminals.

SAN FRANCISCO, CAL.—A new electric road to connect the towns of Pacific Grove, New Monterey, Monterey and Oak Grove with Del Monte is to be built. The plans involve the expenditure of $180,000, and the road will be four and one-half miles in length. It is stated that a deal will shortly be concluded whereby the present horse-car line from Santa Cruz to Seabright will be converted into an electric road and extended to Capitola.

CHAMBERSBURG, MD.—The Chambersburg, Greencastle & Waynesboro Electric Railway Company, which has been given franchises in Greencastle and Waynesboro for a trolley road, has purchased, or agreed to, the turnpike running from McConnellsburg, the seat of Fulton County, where there is no railway of any sort, through Mercersburg to Greencastle, a distance of forty miles, and will build its line over that route, running first from Greencastle to Pen-Mar.

CHICAGO, ILL.—A syndicate said to be largely backed by eastern capital is making plans for the construction of a twenty-foot dam that will give navigable water in the rapids of the Des Plaines River and be a connecting link in the deep water-way from Chicago to the Gulf. The initial object of the dam will be to create from 10,000 to 12,000 horse-power to be used in generating electric energy for transmission to Chicago. It is to be located at Lake Joliet, about two miles south of the city of Joliet, where options on property have been secured.

PITTSBURG, PA.—It is stated that a new company known as the Crawford County Street Railway will build an electric road to run from Meadville to Titusville, a distance of twenty-seven miles, to cost $500,000 complete. Bids will be accepted until August 1, and the work of construction will begin as soon as the contract is let. The venture is backed by William Scott, of the Consolidated Ice Company; Frederick Gwinner, David and William Morrison, David L. Starr, Andrew H. Mercer, Thomas R. Kerr, William J. Parker, David Shaw and Charles Elste.

NEWBURGH, N. Y.—Articles of incorporation of the Intervale Traction Company were filed with the Secretary of State at Albany recently. The purpose of the company is the construction of an electric railroad extending from Newburgh to Goshen, a distance of twenty-eight miles. The directors are: Hiram B. Odell, Graham Witschof, J. A. P. Ramsdell, W. Johnston McKay, Newburgh; Charles W. Griffith, Charles D. Hobbs, Louis W. Stolesburg, Charles A. Burt, Alfred C. Greening, New York; William P. Lockwood, Henry A. Pressey, Washington, D. C.; Edward R. Emerson, Hector Moffatt, Washingtonville; E. J. Richards, Mechanicsville; Dr. Frederick W. Seward, Goshen, and Henry M. Fitch, Middletown.

TELEPHONE AND TELEGRAPH

BALTIMORE, MD.—The Maryland Telephone Company has decided to consolidate the Hagerstown company with those of Montgomery and Carroll counties.

ROANOKE, VA.—Judge Jackson recently granted a charter to the Whythe Mutual Telephone Company, of Whythe County, and one has also been given to a new telephone company in Floyd County.

MCMECHEN, W. VA.—Subscriptions have been received by the National Telephone Company for telephones to be installed as soon as its new line extending to the southern limits of the town is completed.

COZAD, NEB.—At the last meeting of the village board the Cozad Mutual Telephone Company secured a franchise. Business men and citizens of Cozad compose the company, the capital stock of which is $2,000.

CHICAGO, ILL.—A new telephone exchange building will be erected at Chicago Heights by the Chicago Telephone Company. Another exchange building, to cost $30,000, will be situated at Laflin and Nineteenth streets.

PASADENA, CAL.—A certificate was recently filed by the Home Telephone Company, of which Mr. J. M. C. Martin is president, setting forth that the capital stock of the company has been increased from $500,000 to $3,000,000.

NEWARK, N. J.—The Auxiliary Telephone Company, which will manufacture and deal in mechanism for telephonic use, was recently incorporated with a capital stock of $100,000. The incorporators are Egbert A. Reynolds, of New York; Henry C. Ware, of Orange, N. J., and C. G. Colyer, of Newark.

KORTWRIGHT, N. Y.—The Davis Telephone Company has been incorporated at Albany to operate lines in Delaware, Otsego, Schoharie, Schenectady, Albany, Chenango and Broome counties. The capital is $10,000, and the directors are: Ferris E. Davis, James K. Penfield, Andrew J. Nicholl, of Delhi and others.

AUGUSTA, ME.—The Stone Telegraph and Telephone Company has been organized at Portland for the purpose of holding and using inventions and patents relating to the telephone and telegraph, and to deal in instruments and accessories pertaining to these departments of the electrical industry.

NEW ORLEANS, LA.—The Illinois Central Railroad's telephone line has been completed and is in operation from Chicago to New Orleans; from St. Louis to Carbondale, Ill., and between Grenada and Water Valley, Miss., making a total distance of 1,045 miles of long-distance telephone used exclusively for the business of the railroad.

CLEVELAND, OHIO—The Federal Telephone Company is closing up the affairs of the corporation and has recently effected several important deals. Among the sales was the Portsmouth Telephone Company which was purchased by Judge J. M. Thomas and others, and a reorganization is in view. The final transfer of the papers in the Willoughby Telephone Company sale was also made recently, the purchaser being Fred. Storm. Negotiations for the purchase of the People's Telephone Company, of Detroit, are still going on and it is believed that there will be developments in this direction very soon.

HARRISBURG, PA.—That the United Telephone and Telegraph Company has been making great progress during the past few weeks in local and long-distance connections is evidenced by the completion of the lines to Elizabethville, Pa., where they connect with the Lykens Telegraph and Telephone Company. The service between Millersburg, Lykens, Elizabethville and Harrisburg is highly appreciated by the company's patrons. New local subscribers are being added daily and installations are being made in the various departments of the State Capitol and the State Arsenal. One interesting feature of the work of this company has been the connection established between the arsenal and the various camps in the vicinity, thus enabling the men stationed there to communicate with their homes.

AUTOMOBILE NOTE

SOME TIMELY SUGGESTIONS FOR AUTOMOBILE DRIVERS—The governors of the Automobile Club of America have ready for distribution a circular to the members of the club. This dwells on the lack of consideration which is given by a few owners of automobiles who drive their vehicles recklessly in public roads. Attention is also called to the manipulation of self-propelled vehicles by those who are unskillful. The circular states that in the opinion of the governors accidents are caused by want of skillfulness in the operator and by defects in construction, and by frightened horses. The first class of accidents can be prevented by not driving an automobile until competent, or by insisting that manufacturers shall use more care in the design and construction; the second class of accidents can be prevented by care in driving an automobile. The circular then goes on to state the symptoms by which fright in horses can be anticipated, and offers many suggestions that automobile drivers, and drivers of horses as well, will find of great value. Considerable space is given to three lessons which might be put into practice for the training of horses in communities where their familiarity with automobiles is not such as to render them free from taking fright. The circular calls attention to the fact that while the law of most states gives automobiles certain rights on the highways, yet there are times when it is dangerous to drive an automobile at the speed permitted by law. In the state of New York the law provides that no person driving an automobile shall drive the same at any speed greater than is reasonable and proper, having regard to the public use of the highways, or so as to endanger the life or limb of any person.

NEW INCORPORATIONS

RALEIGH, N. C.—The Albemarle Telephone Company; increased to $5,000.

BLOOMINGTON, ILL.—Home Telephone Company; increased from $30,000 to $100,000.

WELLINGTON, OHIO—The Wellington Telephone Company. Capital increased from $10,000 to $20,000.

WINDSOR, ILL.—Windsor Mutual Telephone Company. Incorporators: H. S. Lilly, A. C. Grays, B. F. Moberley.

SALEM, ORE.—The Consolidated Power Company. $100,000. Incorporators: Frank S. Baillie, H. S. Bowen and John L. Rand.

WAXAHACHIE, TEX.—Ellis County Independent Telephone Company. $100,000. Incorporators: A. E. Shaffer, J. B. Earle and Tony Shaffer.

FARGO, N. DAK.—Northern Electric Company. Incorporators: John S. Watson, D. G. Maclay, Alex. Stern, Max Stern and Maurice Kaufman, of Fargo.

EASTHAMPTON, N. Y.—Easthampton Electric Light Company. $48,000. Directors: Everett Herrick, New York; G. L. McAlpin, S. S. Quackenbush, Easthampton.

WILMINGTON, DEL.—Improved Hydrocarbon Light Company. $500,000. Incorporators: Howard Watkin, Wynnewood, Pa.; Watson B. Rulon, Philadelphia, Pa., and Harry Emmons, Wilmington, Del.

SANTA FE, N. M.—Capital Light and Power Company. $700,000. Incorporators: Daniel W. Miller and George Miller, of Toledo; John P. Conner, Anthony Windsor and Herschel E. Gibson, of Santa Fe.

LEAVENWORTH, IND.—The Leavenworth Electric Railway Company. $10,000. Directors: Thomas P. Ellsworth, Henry H. Lester, Stuart A. Beals, Simon E. Grimes, William W. Conrad, Joseph Bell and Oliver E. Hawn.

FRANKLIN, IND.—The Franklin-Southwestern Traction Company. $10,000. Directors: William G. Irwin, Carl E. Willan, Thomas E. Valentine, William B. Jennings, Herbert M. Fisher, John E. Jolliffe and Benjamin B. Brown.

MAPLETON, IOWA—Mapleton Valley Telephone Company. $50,000. Incorporators: Charles I. Whiting, W. H. Leachen, C. H. Smith, T. B. Lutz, J. C. Hammond, Charles G. Chockerell. Officers: C. I. Whiting, president; W. H. Leachen, vice-president; C. H. Smith, secretary; T. B. Lutz, treasurer.

LEGAL NOTE

LIABILITY OF RAILROAD COMPANY—A railroad company which organizes a company to construct an extension of its system into another state and through it operates such extension is held, in Buie *vs.* Chicago, R. I. & P. R. Co. (Tex.) 55 L. R. A. 861, to be properly regarded as doing business in the latter state, so as to be liable to suit there, on causes of action arising out of the state, by service of process upon the officers of the new company.

ELECTRICAL SECURITIES

A very general advance in prices has been recorded during the past week, some of the gains being of large proportions. The sentiment that a bull boom is in order is being regarded with distrust, however, and this is particularly noticeable among certain conservative banking and commission firms. In spite of this doubt the advance in prices has been steady with a few and only temporary interruptions. The monetary situation promises to grow in prominence in the immediate speculation. The money outlook is not so promising for a continuance of the bull movement and the heavy loans of the western element is a decided factor in the outlook. The position of the local banks, with loans many millions in excess of last year, is not strong and the deposits are less than last year, with reserves also lower. The increase of $10,000,000 in the loans, shown in the last banking statement, reflects the effect of the recent expansion in speculation, and in the future local banks will have to consider ways and means of reducing such accommodations. That the general prosperity, however, continues unabated is shown by the weekly report of railroad earnings, bank clearances and practically all trade reports. This forms the foundation for a successful bull manipulation. The crop outlook is very favorable, especially as regards the corn and cotton crop. The coal strike hangs on and the cost of this labor controversy is assuming large proportions.

ELECTRICAL SECURITIES FOR WEEK ENDING JULY 26.

New York:	Closing.
Brooklyn R. T.	69¼
Con. Gas	224¾
Gen. Elec.	187½
Kings Co. Elec.	203
Man. El.	134⅜
Met. St. Ry.	150
N. Y. & N. J. Tel. Co.	175
Westinghouse Mfg. Co.	218

The directors of the Westinghouse Electric and Manufacturing Company have declared the regular quarterly dividend of 1¾ per cent on the ascending stock payable August 15.

It is understood that the business of the Consolidated Gas Company has increased materially in the last few months. The coal strike has increased the use of gas stoves and ranges, while the company, not using anthracite coal, has not had its ratio of cost very greatly increased. The growth of business in the northern part of the city supplied has been rapid through the construction of new buildings. It is said that the electric light business has improved and there has been a marked increase in the value of portions of the company's real estate.

When the stock rights on General Electric were announced, there were speculations, says *The Wall Street Journal*, as to the probable price of the stock rights. An insider believed that it might reach 180. Surprise has been evidenced at the company's business thus far this year. Sales for the four months ending May 31 amounted to $10,175,379. The cost of manufacturing and selling was $7,891,707, leaving a profit of $2,813,672. The profits on sales and securities of other companies royalties, interests and dividends, made a net for four months of $2,283,921, or almost 5½ on the present volume of stock, $42,031,600.

Boston:	Closing.
Am. Telep. & Tel.	165
Edison Elec.	280
Mass. Elec. pf.	97½
New England Tel.	145
Western Telephone & Telegraph	102½

Philadelphia:	Closing.
Elec. Co. of America	8¾
Elec. Stor. Bat. c	92
Elec. Stor. Bat. pf.	92
Philadelphia Elec.	5¾
Union Traction	45⅛
United G. I. Co.	109½

There was lively trading in the electrical securities during the week. Union Traction reached 46, Philadelphia Rapid Transit rose to 12⅜, Electric Storage Battery was well traded in, Philadelphia Electric was strong and United Gas Improvement was very active.

Chicago:	Closing.
Chicago Edison Light	177
Chicago Telep.	169
Metropolitan El. pf.	92
National Carbon	30¼
National Carbon pf.	100½
Union Traction	18
Union Traction pf.	51

The Allis-Chalmers Company, Chicago, U. S. A., has declared fifth consecutive quarterly dividends of 1¾ per cent, payable August 1, out of net earnings.

The recent changes in the board of directors of Chicago Union Traction are believed to have a great deal of significance. Messrs. Weidner, Dickinson, Hutchinson and Billings retired, their places being taken by Messrs. Joseph Donald, George H. Foreman, John Lambert, and William F. Harrity, of Pennsylvania.

ELECTRIC LIGHTING

WILKESBARRE, PA.—The West Electric Light, Heat and Power Company has secured a contract for lighting the borough of Plymouth for ten years beginning February, 1903.

COLUMBUS, OHIO—The East Columbus Heating and Electrical Company has been granted a twenty-five-year franchise. The company proposes to operate within the city limits, and will begin work at once.

BALTIMORE, MD.—At a special meeting of the United Electric Light and Power Company held recently, President George R. Webb resigned as president and a director, and General John M. Hood was elected president to succeed him.

SANTA FE, N. M.—The Capitol Light and Power Company has asked the city council for a franchise to erect its proposed line in Santa Fe. The company will build a dam across the Pecos, near Nadho, and will use the 5,000 horse-power developed there for industrial enterprises at Santa Fe.

COSHOCTON, OHIO—The Merchants' Electric Light and Power Company has experienced quite a change in the ownership of interests. W. A. Himebaugh purchased all of the stock held by J. D. Severns, C. F. Gosser and C. B. McCoy, who have terminated their connection with the company.

STEELTON, PA.—The Home Electric Light, Heat and Power Company, of Steelton, has been chartered, with a capital of $1,000. The directors are Arthur R. Rupley and W. H. Boyd, of Carlisle, and Stephen J. Boyd, of Steelton. The new company will furnish the power for the trolley line which will cross the river when the bridge is built.

MANKATO, MINN.—The Merchants' Protective Association recently decided to organize another electric light company, to afford competition in commercial and city lighting, and a committee was appointed to have charge of the work of organizing a stock company. The capital stock will be in the neighborhood of $75,000, and work will be pushed rapidly.

LE ROY, N. Y.—All of the property which the Le Roy Gas and Electric owned on November, 1899, together with its franchises, etc., have been sold at auction. The sale was made by virtue of the foreclosure of a mortgage on the property held by the Rochester Trust and Safe Deposit Company, whose claim, with costs, amounted to $40,000. J. H. Ward, of Batavia, secured the property, bidding $11,100.

HELENA, MONT.—The new owners of the Helena Power and Light Company have incorporated as the Helena Light and Traction Company, and have filed articles with the Secretary of State. The directors are Thomas A. Marlow, Henry M. Parchen, Albert L. Smith and Norman B. Holter, of Helena, and Kenneth Clark, of St. Paul. The capital stock is $100,000, in $100 shares, of which $500 is subscribed.

NEWARK, N. J.—A mortgage for $5,000,000, the Paterson & Passaic Gas and Electric Company figuring as the mortgagor and the Paterson Safe Deposit Company as the mortgagee, has been recorded in the county register's office. It covers all the real estate and chattels of the gas and electrical concern, the easements, franchise rights, etc. The date of the mortgage is March 1, 1899. The bonds called for by the document will number 5,000, have a value of $1,000 each, and bear five per cent interest.

FULTON, N. Y.—An election of officers of the Fulton Electric Light, Heat and Power Company was recently held in New York, with the following results: President, Silas W. Burt, of New York; vice-president and manager, L. W. Emerick, of Fulton; secretary and treasurer, R. H. Rucker, of New York. This company recently equipped its plant with new and more modern machinery. A substantial two-story brick building has been built as an addition to the plant and an extensive tract of ground has been acquired. The machinery which has been installed will give a capacity of at least 1,000 horse-power, the four dynamos now in use being replaced by two large Westinghouse generators. These improvements represent a vast outlay of capital.

INDUSTRIAL ITEMS

DUNBAR BROTHERS, Bristol, Ct., are manufacturers of an oil-tempered steel spring which they claim is especially adapted for electrical purposes. This company was established in 1845.

THE MAGNET WIRE COMPANY, 141 Broadway, New York, reports that owing to the constantly increasing demand for its product it has again made several extensions in its Newark plant.

THE AMERICAN TOLL TELEPHONE COMPANY, Cleveland, Ohio, has just secured a contract for equipping the public stations of the Keystone Telephone Company, Philadelphia, with its three-slot pay stations.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., illustrates its type MPL direct-connected generators in Bulletin No. 1024. An illustration of this machine also appears in the company's unique July calendar.

MR. G. M. GEST, the conduit contractor, has just received through his Cincinnati, Ohio, office the contract for the underground work of the Bell Telephone Company, of Cincinnati. This will amount to nearly one hundred thousand duct feet.

MR. WILLIAM D. MARKS, consulting engineer, has issued the fifth chapter, in pamphlet form, of "Financing of Gas and Electric Manufacturing Enterprises." This is a mathematical elucidation of the expense accounts of these enterprises.

THE ANDERSON TOOL COMPANY, Anderson, Ind., manufactures the "Anderson" direct-current enclosed arc lamp. Every lamp is guaranteed, and the lamp contains comparatively few parts and is long lived. Interested parties should write to the company for particulars.

THE BALTIC MINING COMPANY, Houghton County, Lake Superior, Mich., has had installed, and is operating, an electric plant. This is one of the plants installed by Frederick N. Bossen, consulting engineer and electrical engineer of the Calumet & Hecla Mining Company, Calumet, Mich.

THE INTERNATIONAL ACHESON GRAPHITE COMPANY, Niagara Falls, N. Y., is distributing a neat mailing card which deals with cable protection. A short sketch discusses the suspension cables of the new East River Bridge, and the use of Acheson graphite as a protection against deterioration.

THE STANDARD VITRIFIED CONDUIT COMPANY, 39 and 41 Cortlandt street, New York city, is distributing a folder illustrating its new form of multiple duct, standard single duct and self-centering duct and the Manhattan third-rail insulator. Mr. R. W. Lyle is president and general manager of the company, and Mr. B. S. Barnard, vice-president and secretary.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., selling agent for Gutmann integrating alternating-current wattmeters, announces that it is about to supply these wattmeters with a glass case instead of the regular aluminum case, where ordered. This allows of a close observation of the meter in operation without exposing the parts to dust or dampness.

MESSRS. GARBE, LAHMEYER & COMPANY, Actiengesellschaft, Aachen, Germany, have prepared a comprehensive catalogue descriptive of their model "V" continuous-current dynamos and motors. The catalogue is carefully indexed and very fully illustrated. It is printed in the German language and will no doubt be of great interest to many who require data of this nature.

MESSRS. MCKENNEY & WATERBURY, 181 Franklin street, Boston, have secured large contracts for electric and gas lighting fixtures the past week, among which are the following: La Fayette Hotel, Portland, Me.; Hampton Hall, Randolph Hall and Westmorly Court dormitories, Harvard College, Hyde Park High School, Hyde Park, Mass., and several fine private houses in New England.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., announces that its business so far for the summer months has been unusually good. Among others it has recently closed a contract with the new Standard Car Wheel Company for all the arc lamps to be used in its new plant, which will probably amount to between 500 and 1,000 lamps, the type used to be the new style made by the Adams-Bagnall Electric Company, of Cleveland, Ohio.

THE WESTERN ELECTRICAL SUPPLY COMPANY, St. Louis, Mo., reports that it is meeting with unusual success in selling the Scheefer integrating wattmeters for direct and alternating current. This meter embodies a number of new and novel improvements. It is claimed to be thoroughly dust and bug-proof, is very highly sensitive and accurate, and is not affected by alternations or lag in current. Prices and descriptive matter will be given on application.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has just closed a contract with the Keystone Telephone Company, Philadelphia, Pa., for a switchboard for its fourth district exchange of 7,200 lines ultimate capacity, and 3,420 lines present equipment. Included in this contract is all necessary apparatus, sneak current and lightning arresters and distributing frames, the exchange being complete in all details and embodying the latest improvements.

DEGGE & MUSICK, 719 Market street, St. Louis, Mo., are introducing an apparatus known as an air diffuser, which may be attached to any fan. It consists of a vertical blade placed immediately in front of the fan, which catches the current of air from the revolving blades for the purpose of spreading it over a larger area. These blades are adjustable, so that all the air current may be diverted at any angle or in any direction or that the diffusing blades may remain stationary.

THE GREEN FUEL ECONOMIZER COMPANY, Matteawan, N. Y., has issued a very complete catalogue descriptive of the Green fuel economizer apparatus. This describes several applications of the Green economizer and gives the results of several tests made quite recently. The descriptive matter is supplemented by much interesting and instructive engineering data, the whole being carefully indexed, making a valuable contribution to this company's literature already in circulation.

THE ECONOMICAL ELECTRIC LAMP COMPANY, New York city, has just received English-Canadian patents on a special form of turn-down lamp. A large order has been secured from the Shelby Electric Company for these lamps, and it is announced that much interest is evinced in this lamp by the steamship companies, on account of the lamp not being affected by vibration and being accessible at any height. A particular form of the lamp is one in which the regulation is effected by drawing on either side of a suspended string.

THE STANDARD POLE AND TIE COMPANY, 44 Broad street, New York city, has just completed the delivery of the second large order from the Central New York Telephone and Telegraph Company, of Utica, N. Y. The poles which have been supplied are the southern white cedar or juniper poles, of which this company makes a specialty, beginning to introduce this pole in the northern market about two years ago; the orders are coming in as fast as they can be handled. The main reasons for the extreme popularity of the juniper pole and its freedom from butt rot and its symmetry and straightness.

JONES & LAUGHLINS, Pittsburg, Pa., are continually making additions to their electrical equipment and have just recently ordered from the Westinghouse Electric and Manufacturing Company, one 800-kilowatt, direct-current generator, two 150-kilowatt, motor-driven, two-phase alternators, and two 125-light motor-driven arc generators. The Doylestown Electric Company, Doylestown, Pa., has recently contracted with the Westinghouse Electric and Manufacturing Company for two 100-kilowatt, engine-type, two-phase alternators with direct-connected exciters, complete with switchboard. The engineer for the work is Dr. W. A. Drysdale, of Philadelphia.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has recently secured the contract from the Tennis Railway Equipment Company for two 600-kilowatt alternating-current generators, to convert the Cincinnati, Georgetown & Portsmouth Railway from steam to electric service. The coke oven blowers in the Buffalo plant of the Lackawanna Iron and Steel Company are to be operated by direct-connected electric motors. Ten induction motors of seventy-five horse-power each have recently been purchased. Four induction motors of 100 horse-power each will be used for operating the gas-cleaning plant, and the machine shop will likewise be driven by induction motors. This company has lately bought in all 151 type C Westinghouse induction motors of from one to one hundred horse-power each. The Fayette Manufacturing Company will use electrical power transmission for driving its new plant for the manufacture of refractory brick at Chester, Pa. The entire power for the mixing and grinding of the ingredients and for conveying the same to and from the various machines and finally pressing them into shape will be furnished by induction motors.